NAVY

Proposal Submission

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research. The Navy SBIR Program Manager is Mr. Vincent D. Schaper. Inquiries of a general nature may be brought to the Navy SBIR Program Manager's attention and should be addressed to:

Office of Naval Research
ATTN: Mr. Vincent D. Schaper
ONR 362 SBIR
800 North Quincy Street
Arlington, VA 22217-5660
(703) 696-8528

All SBIR proposals should be submitted to the above address and must be received by the date and time indicated in Section 6.2 "Deadline Of Proposal" appearing in the front part of this DOD solicitation.

The Navy's SBIR program is a mission-oriented program which integrates the needs and requirements of the Navy primarily through science and technology dual-use, critical technology topics. A total of 31 Science and Technology (S&T) areas has been identified (see Table 1). While all of these areas may not be funded equally during the two annual DOD SBIR solicitations in which the Navy participates, topics will be funded according to a priority it has established to meet its mission goals and responsibilities.

This solicitation contains a mix of broad topics and single narrow topics. Please read the information contained in this solicitation carefully before sending your proposal. This solicitation contains a greater amount of broad topics, permitting greater latitude for small businesses to submit their solutions to Navy requirements. Be aware that the Navy is attempting to determine the effectiveness of such a solicitation. Your reaction to the form and substance of these solicitation topics vis-a-vis those of previous solicitations sent on a separate sheet of paper along with your proposal would be appreciated. Also be aware that the Navy is shifting the participation emphasis of its SBIR Program solicitation from the first solicitation (eg 95.1) to the second solicitation of the fiscal year (eg 95.2). Therefore this solicitation has is a lower level of participation (fewer topics) from Navy activities. This solicitation does have participation from Marine Corps, Naval Air Systems Command, and Naval Sea Systems Command.

When preparing your proposal keep in mind that Phase I should address the feasibility of the solution to the topic. Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees which have been invited to submit a Phase II proposal by the Navy technical point of contact (TPOC) during or at the end of successful Phase I effort will be eligible for a Phase II award. All Phase I and Phase II proposals should be sent to the Navy SBIR Program Office for proper processing. Phase III efforts should be reported to the SBIR program office noted above.

As in the past solicitation the Navy will provide potential awardees the opportunity to reduce the gap between Phases I & II if they provide a $70,000 maximum feasibility Phase I proposal and a fully costed, well defined ($30,000 maximum) Phase I Option to the Phase I. The Phase I Option should be the initiation of the demonstration phase of the SBIR project (i.e. initial part of Phase II). When you submit a Phase II proposal it should consist of three elements: 1) a $600,000 maximum demonstration phase of the SBIR project (i.e. Phase II); 2) a transition or marketing plan (formerly called "a commercialization plan") describing how, to whom and at what stage you will market your technology to the government and private sector; 3) a Phase II Option ($150,000 maximum) which would be a fully costed and well defined section describing a test and evaluation plan or further R&D if the transition plan is evaluated as being successful. While Phase I proposals with the option will adhere to the 25 page limit (section 3.3), Phase II proposals together with the Phase II option will be limited to 40 pages. The transition plan should be in a separate document

Evaluation of proposals to the Navy will be accomplished using in-house Navy and other government scientific personnel, depending on the topic or proposals involved. Selection of Phase I proposals will be based upon

technical merit and other criteria as discussed in this solicitation document. Due to limited funding, the Navy reserves the right to limit awards under any topic and only those proposals considered to be of superior quality will be funded.

TABLE 1. NAVY MISSION CRITICAL SCIENCE AND TECHNOLOGY AREAS

TECHNOLOGY	SCIENCE
Aerospace Propulsion and Power	Computer Sciences
Aerospace Vehicles	Mathematics
Chemical and Biological Defense	Cognitive and Neural Sciences
Command, Control, and Communications	Biology and Medicine
Computers	Terrestrial Sciences
Conventional Weapons	Atmospheric and Space Science
Electron Devices	Ocean Science
Electronic Warfare	Chemistry
Environmental Quality and Civil Engineering	Physics
Human-System Interfaces	Electronics
Manpower and Personnel	Materials
Materials and Structures	Mechanics
Medical	Environmental Science
Sensors	Manufacturing Science
Surface/Undersurface Vehicles	
Software	
Training Systems	

SUBJECT/WORD INDEX TO THE NAVY SBIR 95.1 SOLICITATION

DEPARTMENT OF THE NAVY SBIR 95.1 SOLICITATION TOPIC TITLES

N95-001Affordable Sensors and Avionics

N95-002Reconfigurable and Adaptive Avionic and Sensor Suites

N95-003Increased Reliability and Maintainability of Avionics and Sensors

N95-004Eyesafe Laser Threat Warning Capability

N95-005Surface Discharge (SD) Low Frequency Acoustic Source

N95-006Improved Attitude/Orientation Measurement Capability

N95-007Fiber Optic Coupled Infrared Focal Plane Array (FOCIRFPA)

N95-008Radar Cross Section (RCS) Reduction Using High Temperature Superconductors (HTS)

N95-009Optical Retromodulated Communication and Tracking System

N95-010Investigate a Robust and Secure Means of Communication for Command and Control of the Multiple Robotic Vehicles and Transfer of Intelligence Data

N95-011Biodegradable Ocean Sensors

N95-012Exploiting Chaos for Signal Processing

N95-013Automatic Data Fusion Display

N95-014Advanced Signal Processing of Impulsive Waveforms

N95-015Wavelet Techniques for Compression of Acoustics Processing Signals

N95-016Development/Integration of Low Cost, Lightweight Collision Avoidance/Identify Friend or Foe (IFF) Capability for Hand Launched Unmanned Aerial Vehicle (UAV) System.

N95-017Prototype Active Acoustics Technology for Use in Classifying Underwater Targets in Shallow Water.

N95-018Cryogenic Detector Package for Multiple Arrays

N95-019Lightweight, High Power/Energy Density, Rechargeable Battery for Robotic Technology Applications

N95-020Solid State Pulsed Power Driver

N95-021Virtual Reality

N95-022Intelligent Interface for Mission Rehearsal

N95-023Automated Feature Extrusion for Photo-real Perspective Scenes

N95-024Quick Response Terrain Visualization

N95-025Real Time Image Compression with Edge Feature Retention for Use During Airborne Reconnaissance

N95-026Spatial Acoustic Sound for Virtual Environment Applications

N95-027Referee Receiver Processing System

N95-028Ceramic Fasteners for Aircraft Joining Applications

N95-029Aircrew Head Support

N95-030High Speed Three Dimensional (3-D) Scanning of Complex Air Flow Fields

N95-031Innovative Small, Heavy Fuel Engine Concepts

N95-032Next Generation Electrolytes for Use in Electrochemical Machining (ECM)

N95-033Structural Fatigue Assessment via NDT/I Techniques

N95-034Durability Modeling of Fiber Reinforced Ceramic Matrix Composites

N95-035Acoustic Sensors Used for Gearbox Vibration Monitoring and Diagnostics

N95-036Advanced Turbine Exhaust Particulate Measurement System

N95-037Engine Composite Blade and Vane Repair

N95-038Advanced Automatic Test System (ATS) Resources

N95-039Automated Composite Scarfing/Step Machining Apparatus for Curved Structures

N95-040Weapon Systems Improvements

N95-041Sensitive Uncooled Micromechanical IR Detector

N95-042Environmentally-Durable, Electrically-Conductive Coatings for High Speed Aircraft Windows and Missile Domes

N95-043Wavelet Transforms in Electronic Warfare (EW) Signal Processing

N95-044Increasing Frequency Coverage Of High Temperature Superconducting Antennas for VHF/UHF Applications

N95-045GPS CCM Improvements

N95-046GPS Telemetry Transmitter

N95-047Arrays of Conformal Waveguide

N95-048Systems and Technologies for Future Amphibious Warfare

N95-049Develop Naval Gunfire Defense against Anti-Ship Missiles

N95-050Simulation of Optical Environmental Effects

N95-051High Repetition Rate Mid-Infrared Lasers

N95-052Combat System Interface Simulation/Stimulation

N95-053Submarine Portable Launch System

N95-054Submarine Low Cost Littoral Water Sonar Passive Localization System

N95-055Development of Adaptive Filtering System to Eliminate CW Interference in Submarine IFM-Based Electronic Support Measure (ESM) Systems.

N95-056Low Light Level Color Imaging with Image Processing

N95-057Innovative Passive Electromagnetic Sensors for Submarines

N95-058Develop an Active Advanced Signal Processing Techniques for Active Sonar Contact Classification

N95-059Develop Adaptive Neural Network Signal Processing

N95-060Develop Advanced Directed Energy/Blast Warheads for Torpedo Applications

N95-061Develop Active/Passive Data Fusion Operator Associate

N95-062Exploration of Sources of Opportunity for Submarine Sonar Systems

N95-063Develop the Dynamic Behavior of a Unmanned Undersea Vehicle (UUV) Surf Zone Vehicle Control

N95-064Radar Simulation

N95-065Develop Concepts for Delivering Logistic Information

N95-066Semi-Portable Antenna Near-Field Scanner

N95-067Develop Robust Estimation for Target Tracking

DEPARTMENT OF THE NAVY
SBIR 95.1 TOPIC DESCRIPTIONS

NAVAL AVIATION REQUIREMENTS

PRODUCT AREA: Avionics and Sensors for Naval Aircraft

Navy landbased and shipbased aircraft require improved sensor and avionics systems to enable them to perform functions of surveillance, fire control, electronic warfare, battle damage assessment, information management and dissemination, and others, in support of Joint Strike, Joint Littoral, and Joint Surveillance missions. Targets and environments of interest include underwater objects (submarines, mines) particularly in shallow waters, ships, aircraft, and land targets in ocean and near-shore environments, under conditions of day and night, all weather, electronic jamming, and deception.

To meet these goals the Navy is looking for innovative solutions which promise measurable improvements in any (or all) of the following three broad areas. The Navy will provide a minimum of two awards from quality proposals from the total proposals received for these first three topics:

N95-001TITLE: Affordable Sensors and Avionics

OBJECTIVE: To improve operational effectiveness in Naval sensors and avionics at an affordable cost.

DESCRIPTION: Affordable sensors and avionics which improve operational effectiveness in areas of detection, identification, location, and tracking. Sensor or processing concepts which apply to single sensors, multiple sensors, or multiple platforms are of interest.

PHASE I: Show feasibility of the concept.
PHASE II: Demonstrate the product.
PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: The technology developed under this SBIR should be useable in the civilian market.

N95-002TITLE: Reconfigurable and Adaptive Avionic and Sensor Suites

OBJECTIVE: To develop reconfigurable and adaptive avionic and sensor suites.

DESCRIPTION: Reconfigurable and adaptive avionic and sensor suites which allow aircraft to be more responsive to unanticipated changes, whether they are caused externally (i.e. the threat environment), or internally (i.e. system failure). Architectural and engineering concepts, which apply evolutionary acquisition approaches to aircraft hardware and software, to ease integration of new systems, and enable reconfiguration of existing systems, are of interest.

PHASE I: Show feasibility of the concept.
PHASE II: Demonstrate the product.
PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: The technology developed under this SBIR should be useable in the civilian market.

N95-003TITLE: Increased Reliability and Maintainability of Avionics and Sensors

OBJECTIVE: To increase reliability and maintainability of avionics and sensors.

DESCRIPTION: Increased reliability and maintainability of avionics and sensors to maximize availability and minimize mission degradation caused by system failures. Concepts employing fault tolerant hardware and software, and use of common modules (i.e. processors, apertures) are of interest.

PHASE I: Show feasibility of the concept.

PHASE II: Demonstrate the product.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: The technology developed under this SBIR should be useable in the civilian market.

N95-004TITLE: Eyesafe Laser Threat Warning Capability

OBJECTIVE: Provide adequate threat warning for future countermeasures systems to be deployed on Naval tactical aircraft.

DESCRIPTION: There is a trend toward constructing laser-guided weapons and laser rangefinders that pose no ocular hazards to friendly forces. The optimum wavelength lasers for eye safety that are the safest operate at 1.54 microns, where the energy is not focused on the retina or absorbed on the cornea but is absorbed in the vitreous humor. The technology to produce lasers capable of operating in the 1.2 - 2.1 micron region of the spectrum is currently available and eyesafe laser systems are presently on the market. These systems are based on Raman-shifted Nd:YAG sources, Erbium-based sources, and will eventually include tunable Optical Parametric Oscillator (OPO)-based sources. This effort will produce a laser warning sensor that will provide adequate warning to EOCM (Electro-optic Countermeasure) systems.

PHASE I: Provide a feasibility study which develops a method to detect eyesafe laser threats at ranges beyond 10 kilometers. This method should cover the near infrared spectrum from 1.1 to 2.1 microns, and must be sensitive at 1.54 microns. The method must include a flexible fiber bundle (> 6 meters length) between the collection optics and the detector to provide isolation against radio frequency interference. The method must identify the laser wavelength to within 20 nanometers, and must classify the laser pulse repetition rate and angle of arrival to within 10% and 3 degrees, respectively.

PHASE II: Develop, test and operationally demonstrate the eyesafe laser warning sensor outlined in PHASE I.

PHASE III: Produce the system demonstrated in the PHASE II effort.

COMMERCIAL POTENTIAL: The detector and fiber technology utilized under this effort will benefit high-bandwidth communications research.

N95-005TITLE: Surface Discharge (SD) Low Frequency Acoustic Source

OBJECTIVE: To Develop Surface Discharge Technology Required for a Controllable Impulsive Acoustic Source.

DESCRIPTION: The Navy is currently using air deployed underwater Sound Underwater Source (SUS) charges to gather oceanographic data. These explosive sources are single charges which yield a nondirectional high power broadband pulse. The disadvantages of these explosive sources are that only one explosive can be packaged per air deployed container and that safety requirements for handling, shipping and storing explosives add costs and constraints to fleet operations. The surface discharge (SD) is a pulsed electrically driven acoustic source generically similar to sparkers. The technology will provide a broadband low frequency acoustic output with multiple ping capability. In addition safety and environmental concerns involving explosives would be eliminated.

PHASE I: The program of research will lead to a demonstration of a three element array at sea. PHASE I will consist of evaluating the technology for A size sonobuoy application. A design study shall be conducted to determine:

(1) The acoustic and electrical efficiency requirements for the source to provide a minimum of four pings at ESL (Energy Source Level) comparable to a four pound SUS charge and packaged in an A size sonobuoy.

(2) The timing accuracy capability for a potential multipulse application.

PHASE II: Develop a single element with driver and test at Lake Seneca. Develop three element over-the-side deployed array for at sea demonstration testing. The array shall include acoustic elements, driver, and power source (battery).

PHASE III: Incorporate the technology into existing programs.

COMMERCIAL POTENTIAL: Technology may have application to oil/seismic exploration. Presently explosive charges are used which require costly safety ,handling and storage methods which would be eliminated with the surface discharge device. In addition multiple blasts from a single device could be provided which would increase the data rate as well as eliminate the need to replenish the fields.

N95-006TITLE: Improved Attitude/Orientation Measurement Capability

OBJECTIVE: Substantially enhance the cost vs. performance aspects of means to determine the attitude or angular orientation of a wide variety of moving devices and platforms, considering both long-term (i.e. absolute orientation) and short-term (i.e. drift and noise) effects.

DESCRIPTION: Gyroscope assemblies of various designs are commonly used to determine the angular orientation of a wide variety of moving devices and platforms, ranging, for example, from vehicle-mounted radar and electro-optical (EO) sensors, up to the vehicle itself. The use of such gyro assemblies entails significant cost/performance trades, with the compactness and high performance needed for demanding applications commanding a high price. Exploiting the principle of using the gyro assembly in an inertial measurement unit (IMU) configuration, and thereby referencing it to the highly accurate velocity data provided by GPS, can provide substantial system cost reductions by enabling the use of a lower performance (and cost) gyro assembly than would otherwise be required for a given level of system performance.

PHASE I: Conduct a performance analysis and design study which predicts the improvements in attitude measurement performance as well as the reductions in system cost achievable through the use of techniques for referencing gyro assemblies to Global Positioning System (GPS)-derived velocity data. Assume the use of gyro assemblies occupying a range of cost/performance "plateaus"; for example, attempt to show that these techniques can make low-cost gyros useful in mid-range applications such as integrated aircraft navigation/flight control at one extreme, while allowing compact ring laser gyros (RLGs) to provide the extremely high performance needed for advanced EO sensor sightline measurement at the other.

PHASE II: Integrate, test, optimize, and demonstrate at least two attitude-determining assemblies based on the referencing of gyros to GPS velocity data, to exhibit the performance enhancement available through use of such a combination. One assembly should be based on use of low-cost gyros and the commercially-available Sensor Positioning System (SPS), to show applicability in mid-range applications. The other should use a compact high performance triad, and the encrypted GPS capability precise position system (PPS) available to government users, to achieve the extremely high attitude measurement accuracy required for advanced EO sensor sightline measurement.

PHASE III: Engineer a product line of complete embeddable "orientation engines" (similar to the vision of a compact GPS receiver as an embeddable "position engine"), which marry a GPS receiver with an IMU assembly and the appropriate embedded processing; this product line will span the range of cost/performance from low-cost commercial applications at one end to high performance military units at the other.

N95-007TITLE: Fiber Optic Coupled Infrared Focal Plane Array (FOCIRFPA)

OBJECTIVE: To develop coherent fiber optic bundles for remote location of infrared focal plane arrays (IRFPA) operating in the 2.0 to 4.8 microns (m) spectral band.

DESCRIPTION: For the application of aircraft missile warning, the Navy is seeking innovative approaches in the development of coherent fiber optics (FO) bundles. Currently, the Navy is developing passive missile warning receiver (MWR) systems for tactical aircraft using IRFPA's (i.e. Rockwell Hybrid Mercury Cadmium Teriluride

(MCT) 25x256 element array) to sense the plume radiation of approaching missiles. Location of the MWR system within the aircraft structure provides the following advantages (a) no aerodynamics obstruction or effects; (b) low radar/optical cross section; (c) low Electromagnetic Interferometer (EMI); (d) convenience in location; and (e) integrated system design with wide angular coverage. The FO bundle shall transfer an input image of 10 millimeter diameter formed by an f/1.3 objective lens over a distance of 10 meters with a maximum loss in transmission of 50% over the spectral band of 2.0 to 4.8 m. The optical quality in terms of resolution and modulation transfer function shall be optimized to provide minimum degradation to an IRFA such as the Rockwell Hybrid MCT 256 x 256 element array with 40 um pixel center to center spacing.

PHASE I: Provide a feasibility study which develops a demonstration of concept utilizing mid-infrared fibers and a portion of the elements of an IRFPA. Perform an analytical study to address fabrication issues to be resolved in development of a coherent fiber bundle during PHASE II FO bundle performance assessment.

PHASE II: A prototype coherent fiber optic bundle based upon PHASE I study will be fabricated, tested and evaluated. The performance will be demonstrated by using a government provided IRFPA and objective lens.

PHASE III: Produce advanced model of fiber-optic coupled infrared Focal Plane Array developed in PHASE II.

COMMERCIAL POTENTIAL: FOCIRFPA commercial applications include diagnostics, like thermography inside engines and machinery; and remote spectroscopy for industrial process control and organic reaction monitoring.

N95-008TITLE: Radar Cross Section (RCS) Reduction Using High Temperature Superconductors (HTS)

OBJECTIVE: Develop radar cross section (RCS) reduced antennas using high temperature superconducting (HTS) and electrically small designs. Obtain data on the change in RCS due to the transition from the normal state to the superconducting state in HTS compared to a normal metal antenna.

DESCRIPTION: Conduct RCS measurements on both existing Government and new and innovative contractor antenna designs. (The Government antenna design for a 500MHz thin film antenna described in IEEE 39(9), 1498). The Government described antenna design is an electrically small half loop and matching network which fits onto a 0.8" x 0.8" substrate. Any and all RCS reduction techniques (including electrically small designs and HTS in the normal state) may be considered for the new and innovative designs.

PHASE I: Develop sufficient data to demonstrate feasibility of an innovative reduced design using HTS as a substitute for normal metal. Provide a report describing the demonstration antenna or antenna system design.

PHASE II: Fabrication and demonstration/comparison of the proposed antenna with other conventional systems of the same functionality. (The Government facilities at China Lake, CA may be made available for the test subject to prior coordination.)

PHASE III: Integrate the proposed reduced RCS antenna into a selected aerial target system for demonstration and evaluation.

COMMERCIAL POTENTIAL: Commercial application possibilities for electrically small antenna technology would include any application where space and/or weight is limited and where power gain and bandwidth requirements are low and where the frequencies are below 2 Ghz. Additionally, the techniques used to modulate RCS should be used to create microwave switches which could prove useful in designing more generic microwave switching devices for commercial purposes.

N95-009TITLE: Optical Retromodulated Communication and Tracking System

OBJECTIVE: To provide a secure line of sight (LOS) optical communications (both voice and data) and tracking link between US Naval aircraft and aviation capable ships.

DESCRIPTION: During the approach and recovery of aircraft (fixed wing, rotary wing and VSTOL) on aviation capable ships, it is essential that the ship and aircraft be able to exchange information over a secure and dedicated transmission link. Exchange of vital recovery data, as well as voice information and commands, is required to assure safe recoveries. Aircraft operations in degraded weather and the potential of a future move towards closed/darkened cockpits adds to the need for this link. An optical solution utilizing 2-5 micrometer laser technology is envisioned.

The optical communications/tracking concept envisioned, but not limited to, could be divided into two main subsystems, a shipboard laser transmitter/receiver and an aircraft retromodulator/receiver. The system should operate over a range of 3 nautical miles to as close as 50 feet while maintaining LOS track of the aircraft. Conceptual systems should utilize an eye-safe, mid-infrared (MIR) wavelength (2-5 micrometer) laser. A MIR wavelength system is desired because it will provide good transmission, higher eye-safety limits than smaller wavelengths, potential use of uncooled detectors, and less costly optical components than for longer wavelengths. Additionally, successful integration of an optical system onto an aircraft platform requires a device mounted on an aircraft's front nose landing gear which is small, lightweight, and is capable of withstanding the dynamic forces involved in landing an aircraft on the deck of a ship.

PHASE I: Provide a feasibility study which develops both a means of optically communicating between aircraft and ship, and a means of tracking the aircraft utilizing MIR. This study should include a definition of system requirements (i.e. format, data rates, types of data, etc), analysis of potential concepts and a determination of the most viable. This study should also consider variants of the main topic such as one-way vs two way communication, communication vs tracking, etc.

PHASE II: Develop, test and operationally demonstrate a flight worthy system with the culmination being the integration into a civil aircraft and a landbased flight demonstration.

PHASE III: Installation and test of a fully operational prototype system on a Navy aircraft operating at sea. To provide a secure line of sight (LOS) optical communications (both voice and data) and tracking link between US Naval aircraft and aviation capable ships.

COMMERCIAL POTENTIAL: New concept can be used in communications, security and surveillance systems, could be used on commercial seabased oil platforms for aircraft approach and landing and also for civil aviation transportation.

N95-010TITLE:Investigate a Robust and Secure Means of Communication for Command and Control of the Multiple Robotic Vehicles and Transfer of Intelligence Data

OBJECTIVE: Develop a low cost, lightweight, and jam resistant multi-channel/multi-access communication system to support robotic reconnaissance and other intelligence gathering applications. The system must provide precise location and command and control of multiple autonomous surveillance platforms simultaneously, overcome the intense electromagnetic interference problems of the battlefield environment, and provide a secure means of transferring high resolution imagery data for exploitation by the user in near-real-time, etc.

DESCRIPTION: Many applications in DoD intelligence operations, including minefield location and surveying and tactical surveillance and intelligence collection, will benefit from the emerging development of small robotic technologies for use on airborne and ground reconnaissance platforms. Robotic reconnaissance systems can enable the successful execution of missions which are currently impossible to perform, can remove people from hazardous environments, and can significantly reduce the cost of operations.

The operator of the robotic vehicles must know the precise position of these vehicles, be able to control their operations, and receive the intelligence data from their sensors in near-real-time. Effective and robust communication between the surveillance platforms and the central controlling station must be provided to accomplish these tasks. This communication is currently being accomplished using commercial data links. The current data links provide only point to point communication, have insufficient data rates, lack security, and are very vulnerable to interference or deliberate jamming. The mission flexibility and operational efficiency of having multiple robotic vehicles reconnoitering a wide area is not possible. Moreover, current state-of-the-art military communications equipment is too large, expensive, and bulky for use on the small robotic platforms.

The robotic communications requirements must focus on a robust waveform that will be less susceptible to RF interference, have sufficient bandwidth for video imagery transfer with enhanced security features, provide multi-access/multi-channel communications between many robotic vehicles and their ground control station, and allow large scale and extended range operation. The proposed robotic communications technology thrust shall concentrate on the following areas of interest: advanced communication signal generation, coding and processing schemes, high density, miniaturization of electronic circuitry with very low power dissipation and be affordable.

PHASE I: Investigate secure and jam resistance multi-channel/multi-access communication technology and the requirements to evaluate MMIC, high density digital components, low voltage technology, link analysis, and tradeoffs.

PHASE II: Develop prototype hardware and demonstrate a secure, jam resistant, multi-channel/multi-access communication system which must be low cost and lightweight to be suitable for use on robotic vehicles.

PHASE III: Produce the advanced communications system for integration on robotic vehicles and operational testing.

COMMERCIAL POTENTIAL: The low cost and lightweight multi-channel/multi-access communications system for robotic vehicles will have many commercial applications such as wireless high speed Local Area Network, remote and secure video distribution, and teleconferencing via mobile phones, etc.

N95-011TITLE: Biodegradable Ocean Sensors

OBJECTIVE: Develop biodegradable hardware components for existing and future sensor systems used in the world's oceans.

DESCRIPTION: Military, civilian, and academic organizations have for many years deployed great quantities of sensors into the oceans of the world for a variety of purposes including submarine detection, oil exploration, and scientific research. A substantial amount of the equipment is considered expendable and while its actual useful life may be short, it is never recovered. At best, it litters the ocean floor without harm to the ecosystem and at worst, degrades in a manner that contributes pollutants and floating debris to the sea. With the current awareness of our responsibility to the environment, there is a need to develop expendable (low Cost) systems which can safely be deployed in the ocean, perform their respective missions, and degrade harmlessly. Typical components include batteries of varying chemistry, floatation devices, electromechanical and fiber optic cables, and watertight housings.

PHASE I: Conduct a survey to identify the kinds of expendable equipment being produced for use in the ocean. As a specific example, analyze a production sonobuoy in detail, and identify innovative concepts for enhancing degradability and reducing negative environmental impact. Assess the impact on producibility and cost.

PHASE II: Follow up on the sonobuoy example by selecting components which have the highest potential for payoff environmentally and represent a significant innovation. Fabricate prototype models and conduct tests to assess/demonstrate degradability relative to corresponding state-of-the-art components.

PHASE III: Modify a representative number of fully functional production sonobuoys and conduct an at sea demonstration of operational performance along side non-modified units. Select a device having a primarily civilian application and repeat the PHASE II component fabrication and degradation test.

COMMERCIAL POTENTIAL: Innovations in environmental degradation in the ocean can be applied to civilian activities such as oil exploration and scientific research.

N95-012TITLE: Exploiting Chaos for Signal Processing

OBJECTIVE: Use the principles or tools of chaos to develop signal processing methods which are significantly enhanced over conventional methods.

DESCRIPTION: Over the last two decades there has been a marked increase in the understanding and development of analysis tools pertaining to nonlinear phenomena. In particular, the field of nonlinear dynamics has provided new insights into the characterization of nonlinear time varying signals. In this effort we seek to apply this new technology and its implications to the field of signal processing. Any methods which will provide real gains over conventional signal processing for detection and classification of signals submersed in noise are of interest in this SBIR.

PHASE I: In the first the contractor will delineate new methods of signal processing using or incorporating techniques from nonlinear dynamics. New methods must be supported by pertinent theoretical considerations and computer simulations. If, for example, the detection problem is being addressed then the appropriate receiver operating characteristic (ROC) curves must be supplied. Any gains purported must be substantiated with quantitative results.

PHASE II: In PHASE II the techniques developed in PHASE I will be applied to real data and quantitative evaluations made. Several cases of real data must be considered and evaluated so as to reduce the statistical uncertainty associated with any data analysis and processing methods.

PHASE III: Prototype signal processing systems will be developed and tested.

COMMERCIAL POTENTIAL: The application of this technology to commercial problems is considered highly probable since the occurrence of chaotic signals is likely. In fact, chaotic signals are potentially present in any nonlinear system. Applications could include medical diagnostics, economic analysis, equipment design, forecasting and prediction, etc.

N95-013TITLE: Automatic Data Fusion Display

OBJECTIVE: Fuse data from advanced multibeam/multimode sensors as well as existing sensors on a high level overview display format.

DESCRIPTION: Advanced multibeam sensors currently under development will significantly increase the amount of data which must be presented to a system operator. In addition, advanced multistatic systems will present the operator with confusing combinations of contact associations if presented on traditional displays. Planned improvements in aircraft display processing capabilities as well as a proposed color display capability can be utilized to reduce and simplify the information presentation to an operator.

PHASE I: Design an innovative data fusion technique or algorithm which simplifies the acoustic data operator-machine interface on Naavy ASW aircraft. The candidate technique may utilize existing, planned, or proposed aircraft display subsystems. In addition, the candidate technique must be capable of accommodating all existing sensors and planned sensors; acoustic or non-acoustic.

PHASE II: Develop, test and operationally demonstrate a working prototype of the best data fusion techniques investigated under the PHASE I SBIR effort on Navy ASW platform.

PHASE III: Produce the fusion techniques demonstrated in PHASE II.

COMMERCIAL POTENTIAL: The data fusion techniques investigated can be applied to future advanced multisensor automobiles and multisensor medical diagnostic equipment.

N95-014TITLE: Advanced Signal Processing of Impulsive Waveforms

OBJECTIVE: Develop an impulsive acoustic source configuration in conjunction with an advanced signal processing technique or algorithm for the purposes of extracting additional information from received echoes.

DESCRIPTION: Multiple discreet sources can be used to achieve a pulse "signature" of the transmit waveform as well as focusing the transmitted energy in the desired direction. The signature pulse is designed such that it can be processed with advanced signal processing techniques to separate clutter from targets in dense environments. To achieve this goal, improvements in NAVY aircraft signal processing capability as well as breakthroughs in impulsive source technology may be necessary.

PHASE I: Design an innovative impulsive source configuration which achieves both high directivity and a signature pulse transmit waveform with desirable clutter rejection properties. In addition, design an innovative signal processing algorithm which fully exploits the properties of the transmit pulse.

PHASE II: Develop, test and operationally demonstrate a working prototype of the techniques investigated under the Phase I SBIR effort. Use of Government furnished input data will be furnished if available.

PHASE III: Produce the signal processing techniques demonstrated in PHASE II on a Navy ASW platform.

COMMERCIAL POTENTIAL: The advanced signal processing techniques and impulsive source configurations developed under this task can be applied to oil exploration beneath the sea floor.

N95-015TITLE: Wavelet Techniques for Compression of Acoustics Processing Signals

OBJECTIVE: Determine the feasibility of utilizing wavelet transform (e.g. Morlet and Daubechies) techniques for the compression of typically large bandwidth data occurring in acoustic signal processing systems. If deemed promising, develop an algorithm based on the chosen wavelet transform(s) that accomplishes acoustic data compression.

DESCRIPTION: Two classes of acoustic signals are candidates for compression, namely, transients and those signals typically processed in the Low Frequency Analysis and Ranging (LOFAR) mode (steady state sinusoidal). Both of these data types require high bandwidth transmission from sensor units to receiver units onboard prosecuting aircraft. To demonstrate feasibility of the wavelet technology, theoretical analysis and preliminary testing must indicate a bandwidth savings of at least 25%. Also the wavelet compression must not degrade detection and/or classification performance associated with the signals. Once feasibility has been demonstrated algorithms will be developed to implement the wavelet compression techniques in a real-time scenario. The final deliverable will be algorithms to produce compression of the transient and LOFAR signals in real-time with no degradation and a test report indicating performance in terms of accuracy and speed.

PHASE I: A feasibility report which will describe the benefits/shortcomings of the technique and will indicate the approach for possible implementation.

PHASE II: Development of the algorithms for compression of the transient and LOFAR signals together with a test report indicating the results of their implementation.

PHASE III: Transition to Advanced Development

COMMERCIAL POTENTIAL: This technology could be useful in any commercial sensor/receiver unit application where high bandwidth signals are utilized.

N95-016TITLE:Development/Integration of Low Cost, Lightweight Collision Avoidance/Identify Friend or Foe (IFF) Capability for Hand Launched Unmanned Aerial Vehicle (UAV) System.

OBJECTIVE: To investigate feasibility of developing lightweight, low cost collision avoidance (CA) and/or IFF technology or using commercially available CA/IFF systems for integration into Hand Launched UAV, then develop prototype for developmental bench and flight testing.

DESCRIPTION: There exists a need to develop and integrate CA/IFF capability into current and future Hand Launched UAV (HL-UAV) systems to improve interoperability with other low flying manned aircraft. The HL-UAV is a hand launched unmanned aerial vehicle system capable of performing tactical surveillance and reconnaissance within a 5-7 km combat radius. The HL-UAV's nominal operating altitude is between 200-500 feet above ground level. The current prototype system uses a single ground control unit with a styrofoam/kevlar composite air vehicle. The electrically powered air vehicle has a 9 ft wingspan, is 6 ft in length, and weighs approx. 8 pounds with payload and batteries. The air vehicle carries the imaging payload (currently a black & white/color camera), electric motor (300 watt samarium-cobalt), uplink receiver, downlink transmitter, avionics and batteries. The ground control unit consists of a pilot controller, observer's monitor, uplink transmitter and downlink receiver.

The existing HL-UAV configuration relies on visual flight rules (VFR) and dead reckoning techniques for navigation and collision avoidance. Since the current HL-UAV does not employ an autopilot/navigation system - it relies solely on manual piloting and navigation. However, an autonavigation system employing global positioning system (GPS) is in development. Employment and operation of this capability, especially in airspace with low-flying aircraft (e.g., urban area with extensive helicopter traffic), could necessitate the need for a collision avoidance or IFF-type transponder. Since the HL-UAV would operate autonomously, and would have an extremely small visual and radar signature, the primary emphasis of a CA/IFF system would be to alert manned aircraft of the HL-UAV's location. The CA/IFF system could also alert the HL-UAV ground operator of manned aircraft within the airspace, allowing the ground operator to initiate automatic/manual collision avoidance procedures.

PHASE I: Determine the availability of existing CA/IFF technology and commercially available systems/components that could meet the stated requirements.

PHASE II: Provide prototype CA/IFF system for bench-level testing at a government facility. If successful, flight tests would follow. The contractor will provide on-site support throughout the duration of the testing, if necessary.

PHASE III: Transition into military and commercial systems.

COMMERCIAL POTENTIAL: Commercial "spin off" potential exists. The HL-UAV is already a front-runner for transition to other government agencies, paramilitary operations, and commercial applications. A CA/IFF transponder would help facilitate transition of the HL-UAV into commercial and civil operations, making the system more flexible, safe and capable.

N95-017TITLE:Prototype Active Acoustics Technology for Use in Classifying Underwater Targets in Shallow Water

OBJECTIVE: The emergence of acoustically quiet threats in dense maritime activity, shallow water and littoral environments has led to the need for active acoustic search and detection systems to replace traditional passive systems. The objective is to study the feasibility and application of innovative active acoustic classification technology to the U.S. Navy maritime patrol aircraft (MPA) and sensors. The initial goal will be to establish a classification capability to reliably distinguish between blue and red (friendly/unfriendly) platforms.

DESCRIPTION: This SBIR Topic will investigate, implement, test and demonstrate prototype active acoustics technology for use in classifying underwater targets in shallow water. Areas to be investigated include: generalizing the target model to incorporate more realistic physics; using Navy-specified existing active signals at search frequencies to more effectively exploit target characteristics; using innovative signal processing techniques, in conjunction with the preceding, to extract currently unused classification information. Analyses will address such issues as: elastic reradiation, frequency filtering, and time delays induced by the target; discrimination between target and noise sources (including bottom clutter). Determine feasibility and recommend an approach having the greatest potential for shallow water active classification. Implement, test and demonstrate a prototype.

PHASE I: Develop an expanded theory of target model physics. Investigate and identify candidate signal designs and processing. Determine the feasibility of alternative approaches, taking performance and Air ASW sensor constraints into account. Document the generalized model physics, all analyses and results, and the alternative approaches in a Technical Report.

PHASE II: Generate a detailed design for a Navy approved approach to subsurface friendly/unfriendly classification in shallow water scenarios. Implement a prototype system. Test it, using quantitative measures of effectiveness, and analyze the test data to determine performance relative to current active classification capabilities. Demonstrate the prototype. Deliverables will be a Final Technical Report, the prototype system (software and hardware), and associated documentation.

PHASE III: Transition to the Air ASW communities.

COMMERCIAL POTENTIAL: Identification of underwater objects.

N95-018TITLE: Cryogenic Detector Package for Multiple Arrays

OBJECTIVE: Develop an assembly for multiple infrared spectral band detector arrays in a single package.

DESCRIPTION: Current infrared sensor designs restrict detector arrays to a single band. Multiple band designs must rely on complex optical configurations to direct the scene energy to separate detectors. Multiple band data is important in analyzing the information for the presence of false targets originating from natural scene emissions or countermeasures. Objects with the wrong energy ratio between the bands can be classified as invalid. Real targets (ships, tanks, aircraft) will exhibit a distinct ratio reducing false alarms and providing a counter countermeasure ability. This effort will focus on the development of a detector package with the capability to provide multiple spectral data. Techniques investigated will include switchable cold filters and optically isolated multiple arrays with integral fixed filters. The resulting package will provide capability for imaging the scene and for a spectral analysis of the potential military targets present in the scene.

PHASE I: Complete the analysis of the candidate designs for a switchable filter configuration. Frame rates, package size, physical detector capacity, reliability, and mechanical complexity will be key measures of performance for the switchable detector design. Analysis of the packaging requirements for multiple fixed arrays will also be conducted noting the trade off between mechanical simplicity and physical detector areas.

PHASE II: Fabricate the superior design approach from the PHASE I effort. Interface to commercially available detector array and conduct lab tests to characterize the package.

PHASE III: Couple the package to a commercial optical telescope. Conduct lab and field tests to demonstrate real world performance.

COMMERCIAL POTENTIAL: This development could be applied to medical instrumentation imagers.

N95-019TITLE: Lightweight, High Power/Energy Density Rechargeable Battery for Robotics Technology Applications

OBJECTIVE: To develop a lightweight, high power/energy rechargeable battery for use by small air platforms

DESCRIPTION: Many applications in DoD intelligence operations, including minefield location and surveying and tactical surveillance and intelligence collection, will benefit from the emerging development of small robotic systems for use on air and ground reconnaissance platforms. The robotic reconnaissance system can enable the successful execution of missions which are currently impossible to perform, can remove people from hazardous environments, and can significantly reduce the cost of operations.

There is a need to develop advanced rechargeable battery technology to improve the performance of existing robotic vehicles which use batteries extensively. Currently, nickel-cadmium (NiCd) battery packs, weighing about one pound and providing approximately 20 minutes of operation, are used. Lithium-sulfur dioxide ($LiSO_2$) battery packs weighing about one pound are also used and supply energy for a longer duration. These are not rechargeable and must be disposed of as hazardous waste.

The proposed battery research will focus on technology that can supply the high energy/power density performance of $LiSO^2$ batteries and still be rechargeable like NiCd batteries. The continued development and refinement of the emerging battery technology will also eliminate the environmental concerns caused by using disposable $LiSO^2$ batteries. Existing technology and research is deficient and have not been focused on small air platform applications in regards to reduced weight, smaller volume, high energy/power density, recharageability, handling safety, and long operating life.

PHASE I: Investigate the emerging rechargeable battery technology which can provide high energy/power density for small air platform applications. Conduct a feasibility study and perform hardware design, technology tradeoffs, and performance analysis.

PHASE II: Develop prototype hardware, and demonstrate a lightweight rechargeable battery pack with high energy/power density for small air platform applications.

PHASE III: Produce the advanced rechargeable battery system for integration on small air platforms and subsequent operational testing.

COMMERCIAL POTENTIAL: The lightweight, high power/energy density rechargeable battery for robotic vehicles applications has many commercial applications, including portable electronic equipment, wireless communications networks, mobile phones, portable facsimile machines, and personal computers, etc.

N95-020TITLE: Solid State Pulsed Power Driver

OBJECTIVE: Develop a compact, all solid state pulse power driver that produces fast risetime electrical pulses to multiple kilohertz repetition rates, for arclamp, flashlamp and plasma discharges application.

DESCRIPTION: A wide variety of commercial and military application exist for pulsed power drivers that are capable of delivering fast risetime, high peak voltages and current pulses to gas-dynamic loads at high pulse repetition rates. Typically, these rates can range from a few hertz up to 20 kilohertz depending on the specific application. The most notable applications involve coupling high power pulses drives to high pressure arclamps and flashlamps, or to low pressure plasma discharge cells, to generate intense optical emission. Additional applications for this technology can be found in the area of radar developments and utilization. An all solid state pulsed power driver would significantly improve the current state of the art in high power electrical switching by eliminating the need to use gas-filled thyration as high power switching elements in the circuit. The elimination of these devices could result in the development of a compact, high density driver suitable for airborne and remote ground-based systems (i.e., countermeasures against infrared guided missiles). Considerations should be given to an initial design concept that can provide pulsed energies up to 1.0 joules at a peak voltage of up to 20 kilovolts into a primarily inductive load imposed by a longitudinal discharge tube. The driver would produce electrical pulse risetimes of less than 30 nanoseconds (10% to 90%) at the load and should operate at pulse repetition rates of up to 10,000 pulses per second continuously with an operating lifetime of more than 10^{11} shots.

PHASE I: Show feasibility of the concept.
PHASE II: Demonstrate the product.
PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: The all solid state, pulsed power driver will have extensive applications potential in the areas of arclamp, flashlamp and plasma discharge ignition and operation, compact radar system design, high intensity light generation and electrical power control and distribution. When this pulsed power driver is applied to excitations of solid state lasers, the specific commercial applications include laser medicine (particularly laser cholercystectomy and dental lasers) laser metal working)

PRODUCT AREA: Training and Simulation

Training and Simulation technologies are responsible for developing synthetic environments to support initial requirements analysis and system development decisions for improved operational and affordable naval aviation systems.

N95-021TITLE: Virtual Reality

OBJECTIVE: Develop virtual reality technology for military applications.

DESCRIPTION: Virtual reality is becoming increasingly important as a tool to provide cost effective alternatives for training and to provide enhanced capabilities for activities such as intelligence gathering, design and test and evaluation. However, much work needs to be done to refine and enhance our ability to portray the virtual environment so that its full potential can be realized for use in these and other military applications. The Navy will provide a minimum of two awards from quality proposals from the total proposals received from this topic:

Acoustical/tactile modeling: Methods need to be developed to more accurately simulate the actual characteristics of acoustic/tactile interaction with the virtual environment.

Data compression techniques: High fidelity, near real-time visualization of terrain over large, seamless geography requires enormous amounts of data. High fidelity compression techniques which increase storage capacity and rapidly transfer compressed data from storage to rendering processes are required in order to deal with the processing of real time updates of information.

Enhanced capabilities for 3-D rendering: Methods which address the requirements for three-dimensional (perspective) rendering (e.g., subpixel edge preservation during pixel magnification, space-variant resolution to match the resolution characteristics of the eye and motion) are needed to improve quality of image rendering.

3-D Imaging.

Material Classification: Automatic or semi-automatic methods for the classification of terrain surface materials based on their reflectance, thermal, emissivity, texture, surface projection and other properties of material are needed in order to enhance the prediction of visible spectrum, infrared (FLIR) and synthetic aperture (SAR) scenes.

Threat Vulnerability: Ever increasing complexity in threat environments requires new methods to dynamically display these threats. Threat characteristics which should be accounted for include aspect ratio and physical attributes as well as other parameters which are critical to aircrew warning.

PHASE I: Show feasibility of the concept.

PHASE II: Demonstrate the product.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: Civilian applications abound for this technology.

N95-022TITLE: Intelligent Interface for Mission Rehearsal

OBJECTIVE: To develop an advanced configuration for realistic, multi-platform mission rehearsal. Current approaches to distributed interactive simulation cannot support the Navy's need for shore-based or deployed mission rehearsal under the demands of actual sensor and crewstation environments. An advanced interface is needed to improve communication protocols by allowing aircrew operating from different simulated platforms to cooperatively preview and rehearse threat engagements.

DESCRIPTION: In combat, aircrew must perform situation assessment under time-compressed data-intensive conditions, coordinate control action with other fleet assets, and minimize sensor and communication emissions. An intelligent interface capable of supporting networked, high fidelity, multi-platform aviation simulations in a realistic sensor environment is required for improved mission rehearsal. This intelligent architecture must consider the multi-sensor capabilities of different platform types and effectively transmit information on the tactical picture to other platforms. The human-system interfacing strategies which allow for cooperative interaction of operators and instructors/system managers (real or artificial) must not require extensive modification or disruption to actual cockpit displays/controls or exceed the capacity constraints of system mission computers.

PHASE I: Provide a report detailing the critical concepts and design features necessary to implement and demonstrate the intelligent interface for single and multi-platform mission rehearsal systems.

PHASE II: Demonstrate and evaluate the effectiveness of incorporating an intelligent interface in both single and multi-platform mission rehearsal systems. The networked mission rehearsal system design will be demonstrated using two or more simulations of dissimilar tactical aviation platforms.

PHASE III: Transition to ongoing and planned Navy and Air Force programs.

COMMERCIAL POTENTIAL: The various features of the operator and system manager-in-the-loop rehearsal system could be easily adapted and used to advantage by commercial airlines in support of cockpit resource management (CRM) training programs. The design concepts could also be extended to commercial shipping interests to support cross-positional and situational awareness training.

N95-023TITLE: Automated Feature Extrusion for Photo-real Perspective Scenes

OBJECTIVE: To develop techniques to automatically extrude man-made and natural photo-image features for realistic dynamic low altitude rendering.

DESCRIPTION: Photo databases are used for a wide range of applications: intelligence, mission preview, planning, rehearsal and training systems. The DOD has acquired the imagery and created photo-real databases that cover vast land masses throughout the world. While these existing databases are valuable for high altitude applications, their utility for low altitude (e.g., helicopter applications) is severely limited. Current techniques to extrude the features which gives the terrain a realistic appearance when it is viewed from ground and near ground level requires significant amounts of time for even modest figures. Automated methods and tools are required to increase the efficiency of, and reduce the time required for, the feature extrusion process.

PHASE I: Provide a report describing the methodology to extrude man-made and natural features in a photo-real database that increases throughput by at least five fold.

PHASE II: Develop, test and operationally demonstrate the feature extraction method formulated under the PHASE I SBIR effort and demonstrate its effectiveness for both shore-based and on-board mission planning and rehearsal systems.

PHASE III: Transition to ongoing and planned Navy and Air Force programs.

COMMERCIAL POTENTIAL: The techniques developed under this effort would greatly enhance the value of satellite and aerial photography data for use in Virtual Reality location-based entertainment and interactive educational applications.

N95-024TITLE: Quick Response Terrain Visualization

OBJECTIVE: To develop techniques to support the use of raw imagery data for terrain visualization.

DESCRIPTION: Photo databases are used for a wide range of applications: intelligence, mission preview, planning, rehearsal and training systems. Current methods vary greatly in the time it takes to prepare the terrain database and to update these databases when new imagery is received. Much of the time processing this data is spent geo-correcting the data using ortho-rectification and "rubber sheeting" techniques. Methods and processes are needed to reduce these time consuming processes to provide realtime databases for photo-real perspective scene generation.

PHASE I: Provide a report detailing the design features necessary to implement realtime data processing to produce a 60 mile, 10-meter (or better) resolution database from raw satellite or photo-imagery and digital terrain elevation data (DTED) in less than 30 minutes.

PHASE II: Develop, test and operationally demonstrate the Quick Response Terrain Visualization method formulated under the PHASE I SBIR effort and demonstrate their effectiveness for both shore-based and on-board mission planning and rehearsal systems.

PHASE III: Transition to ongoing and planned Navy and Air Force programs.

COMMERCIAL POTENTIAL: The technique developed under this effort would be applicable to satellite and aerial photography data processing and related photogrammetry.

N95-025TITLE: Real Time Image Compression with Edge Feature Retention for Use During Airborne Reconnaissance

OBJECTIVE: Devise a concept for "real time" compression of video imagery collected during airborne reconnaissance which, when decompressed, maintains the textures and edges of the original image.

DESCRIPTION: A proof-of-concept is sought that demonstrates real time compression (and subsequent fast time decompression) at a rate of 30 video frames per second. The technique must maintain image quality for subsequent image enhancement and automated computer processing. The image compression/decompression techniques examined in PHASE I of this SBIR must be compatible with a real time digital communication error detection and

correction (EDAC) scheme and extensible to larger 1024 x 1024 pixel video images. Absolute preservation of edges is a mandatory requirement. However, an extremely high compression ratio (>20:1) is desired. The image compression/decompression technique must be applicable to up and down linked satellite communication (6 MHz bandwidth) or the 7 Mhz bandwidth Modular Interoperable Data Link (MIDL) relay of color video images or second generation imaging IR (IIR) video images.

PHASE I: Define "real time" image compression/decompression algorithms (or techniques) applicable to color National Television Systems Committee (NTSC) video with fixed backgrounds and no foreground object movement. PHASE I efforts should also examine the applicability to 256 x 256 pixel imaging infrared (IIR).

PHASE II: Demonstrate real time image compression/decompression algorithms (or techniques) applicable to color NTSC video with fixed backgrounds and no foreground object movement. PHASE I efforts should also examine the applicability to 256 x 256 pixel imaging infrared (IIR).

PHASE III: PHASE III efforts should examine the application of the image compression, processing and error control technique to both military seekers and to digital (Advanced Television Research Consortium) high definition television (HDTV) video format images with fixed background/foreground; or, (b) fixed background/moving foreground objects.

COMMERCIAL POTENTIAL: Transmission of high definition television (HDTV) video images using conventional broadcast equipment and higher capacity on cable transmission systems.

N95-026TITLE: Spatial Acoustic Sound for Virtual Environment Applications

OBJECTIVE: Develop digital hardware and software technology to provide flexible, realistic, localized sound for use with virtual environment applications.

DESCRIPTION: The two primary techniques for spatial sound production involve the use of either external speakers or headphones. The pitch and volume of a sound sample can be sliced and placed within a cube of speakers to produce the illusion of localized sound. This method, however does not account for the acoustic properties of the physical space, and therefore, can be relatively coarse. It is predominantly used for applications with many simultaneous users of systems where the user cannot be required to wear a device. The alternative is to localize the sound using a head-related transfer function and manipulate the sound sample with respect to the human head. Recent systems are extremely limited in both the number of simultaneous sound-emitting sources and the quality and fidelity of the sound itself. Current needs and requirements call for a digital hardware and software technology solution which is capable of real-time computation and manipulation of the sound taking into consideration all acoustic effects such as Doppler shift and reflectance. The device must be fast (able to synchronize with real-time computer graphics) and flexible. Typical virtual environment systems prefer a headphone-based system due to their single-user nature.

PHASE I: Provide a thorough investigation of possible solutions which address the needs and requirements listed above. A report describing the proposed solution, its technological improvements over past solutions, and its expected performance specifications will be required.

PHASE II: Develop, test, and demonstrate the solutions described under the PHASE I effort.

PHASE III: Produce the system developed under the PHASE II effort.

COMMERCIAL POTENTIAL: Spatial sound systems are a necessary component of all virtual environment applications. Their development will encourage wider use in creating more effective virtual environment systems.

N95-027TITLE: Referee Receiver Processing System

OBJECTIVE: Develop digital receiver technology which provides for real-time determination of electromagnetic ground truth during the conduct of at-sea/range testing of Electronic Warfare (EW) and missile systems.

DESCRIPTION: The Navy conducts extensive flight tests to evaluate the performance of EW and missile systems. The requirement to test in a realistic environment often places a considerable demand on range instrumentation use to collect data for test reconstruction. Analysts must carefully reconstruct the test environment in order to determine the overall effectiveness of the system under test. Develop digital receiver technology featuring Surface Acoustic Wave (SAW) devices and high speed R-to-D converters to enable high fidelity processing of the electromagnetic signal spectrum. The processed data is to be time tagged and displayed, both, spectrally and temporally. The system would serve as a referee to independently document the responses of the system(s) under test.

PHASE I: Upon examination of appropriate test plans for conducting at-sea tests of EW systems against antiship missile simulators, develop a conceptual approach using modern receiver and processing technology to record the electromagnetic spectrum present in this environment. The relatively low signal density provides an opportunity to employ analytical techniques which permit accurate reconstruction of the jamming signal's spectrum as well as that of the missile seeker's radar. Interfaces to other instrumentation and reference sources is also required for accurate events reconstruction. A report defining the requirements, potential solutions, tradeoffs and recommended technological approach being considered shall be required.

PHASE II: Based on the results available from the PHASE I study and subsequent review by personnel from the Navy's T&E community; develop, the receiver technology for evaluation in an actual test situation and demonstrate the benefits derived from the addition of this capability into the test environment.

PHASE III: The technology and modular design approach demonstrated in PHASE II of this SBIR would be available for incorporation into range instrumentation packages used throughout DOD's T&E community.

COMMERCIAL POTENTIAL: The increased use of the electromagnetic spectrum creates the necessity to cost effectively monitor the frequency spectrum for signal quality and compliance with established standards. This

technology, developed from a modular perspective, could be tailored to support non DOD agencies in insuring proper use of the spectrum.

PRODUCT AREA: Aircraft Systems and Support

Aircraft Systems technologies include Air Vehicles, Propulsion, Aircrew Systems, Materials, Structures and Shipbased Support Systems. Aircraft Systems for naval aviation differ significantly from those of other services in that they must operate in a maritime environment, including those conditions associated with the aircraft carrier and other air-capable ships. The environments include: corrosion/salt spray, deck and elevator space limitations, size/weight restrictions, longer missions, over and underwater egress and survivability, turbulence and deck motion, precision controls, shipboard electromagnetics, unique visual conditions, special night operations, high lift, low speed, rapid engine response, special landing gear, special supportability and maintainability considerations (no cranes, no ladders, self-contained repair, etc.) and general aircraft performance in these severe conditions. The components and systems developed must be affordable, sustainable and supportable. Goals in Aircraft Systems include: improved safety and effectiveness in launching and recovering sea-based aircraft, reduced cost of ownership and improved readiness, increased force mission capability, and increased operational effectiveness and more survivable aircraft.

N95-028TITLE: Ceramic Fasteners for Aircraft Joining Applications

OBJECTIVE: To develop lightweight and durable fasteners for joining components made from graphite reinforced polymeric and ceramic materials with similar materials and with metallic materials on current and emerging aircraft which can be used in both high temperature regions and in applications requiring galvanic isolation

DESCRIPTION: Current practice is to use metal fasteners for structural joining in high temperature regions near aircraft engines. Metal fasteners are also used for joining graphite reinforced composite panels to galvanically dissimilar metallic components, where sealants are applied to the outer and mating surfaces of the metallic components for galvanic isolation to prevent induced corrosion. The purpose of this program is to develop alternative ceramic-based fasteners for replacing the metals fasteners on both of these aircraft joining applications.

PHASE I: Develop fastener design(s) suitable for both of these aircraft joining applications. Fabricate and test material system for demonstration of improved galvanic isolation properties to those of current fastener design.

PHASE II: Develop and fabricate prototype ceramic fasteners. Demonstrate the capability of the new fasteners to replace existing fasteners. Assess the benefits of using ceramic fasteners and develop a manufacturing plan.

PHASE III: Produce the hardware demonstrated in PHASE II.

COMMERCIAL POTENTIAL: Ceramic fasteners would find use in high temperature automotive and aircraft applications.

N95-029TITLE: Aircrew Head Support

OBJECTIVE: Design, develop, fabricate and test an innovative device which will provide support to the neck and head to markedly reduce the maneuvering and ejection loads on the aircrew's cervical spine.

DESCRIPTION: The vertebrae are the most frequently injured body part in naval ejections over the past 20 years. The cervical spine supporting the neck, head and all head supported weight has proven to be particularly vulnerable. In fact, serious cervical and spinal cord injuries have resulted from otherwise benign ejections. Unless positive solutions are found, the frequency of vertebral injuries will increase in the future due to operating in and ejecting from highly maneuverable, dynamically unstable, aircraft. This condition will be aggravated in combat when urgency of ejection will preclude removal of the night vision equipment prior to ejection.

A neck and head support system would decrease ejection injuries when wearing the added head supported weight of night vision capable systems. Reference (1) describes how the spine can remain uninjured during spinal compression and bending. Since the ejection seat acceleration is constant, weight added to the head can produce sufficient compression and bending forces in the spine to cause injury and fatality. One method proven successful, using inflatable bladders, has been used on human ejection tower tests to control head rotation and assure correct axial spinal loading (Reference (2)). In rotary wing and non-ejection seat equipped fixed wing, where crash

survivability is required, the Inflatable Body and Head Restraint Systems (IBAHRS) technology (Reference (3)) is a potential approach used. The IBAHRS system inflates bladders, when a crash pulse is sensed, to provide crash protection by limiting the rotation of the head and torso.

PHASE I: Provide a thorough operations analysis to define the aircrew head support problem and establish the operational criteria and design and performance requirements. Accomplish a trade study leading to a selected design approach. The study must include in-flight performance, protection during ejection, weight, cost, environmental effects, as well as, materials, manufacturing and logistic support considerations. Based upon this work, conceive a design and complete a preliminary design of the proposed solution.

PHASE II: Complete a prototype design and conduct critical experiments and feasibility testing to verify the concept and its ability to perform as required by the operations analysis and other criteria identified in PHASE I.

PHASE III: Complete the design and fabrication and conduct development testing.

COMMERCIAL POTENTIAL: This work can produce advanced improvements for automobile crash protection, sports injury protection and crash impact protection for the general aviation industry.

N95-030TITLE: High Speed Three Dimensional (3-D) Scanning of Complex Air Flow Fields

OBJECTIVE: Increase the area mapping capability of light detection and ranging (LIDAR) based remote wind sensors.

DESCRIPTION: The airwake velocity field in the aircraft recovery envelopes for aviation capable ships is extremely complex. Turbulent vortices generated by the ship's superstructure change direction and intensity with the magnitude and direction of the wind over the deck (WOD) as well as with ship motion. This complex flow field directly affects the pilot's control of the helicopter on approach, hover, landing and deck operations. This problem is further complicated by the addition of flow disturbances caused by the aircraft. The Navy is currently developing a LIDAR which is capable of measuring the wind that aircraft encounter along the approach and recovery flight paths and directly over the flight deck. Performance and accuracy of current scanning methods are limited by wind turbulence and size/type/orientation of the sensor. The Navy desires to investigate a scanning method which will operate at high speed and allow the shipboard LIDAR the capability of fully and accurately mapping a 100 x 100 x 50 foot area in real time.

PHASE I: Provide a feasibility study which develops a method for high speed 3-D real-time scanning of a shipboard LIDAR system. The study should investigate various processing techniques including digital and optical implementation. The study should also include a preliminary design of the system, including hardware.

PHASE II: Develop, test and operationally demonstrate the scanning system formulated under the PHASE I SBIR effort.

PHASE III: Integration into the Navy's LIDAR wind sensor and test of the fully integrated operational system on a Navy ship.

COMMERCIAL POTENTIAL: New concept can be incorporated in all LASER remote wind sensors including those employed in civil/commercial aviation by the FAA to detect wind shear and microbursts.

N95-031TITLE: Innovative Small, Heavy Fuel Engine Concepts

OBJECTIVE: To examine breakthrough, state-of-the-art, innovative small heavy fuel engine concepts to determine feasibility of concept.

DESCRIPTION: The DOD desires to consider advanced innovative small internal combustion engine concepts that will advance the present state-of-the-art (power to weight) in the 25-100 horsepower range, with applications including unmanned aerial vehicles, generator sets and portable fire pumps. Innovative concepts and design shall focus on both diesel and JP-8 fuel (heavy fuel) operation and lightweight construction. Engine concepts shall have power to weight ratios approaching 1.0 and brake specific fuel consumption not exceeding 0.7 lbs/hp-hr.

PHASE I: Conceptual designs shall be generated and validated through theory, analysis and subscale testing.

PHASE II: Fabrication of full scale designs and experimental verification of the concept.

PHASE III: Produce limited numbers of pre-production engines for field demonstrations and validation.

COMMERCIAL POTENTIAL: Numerous uses of small gasoline engines would be replaced by equivalent performing diesel fuel engines that are inherently safer.

N95-032TITLE: Next Generation Electrolytes for Use in Electrochemical Machining (ECM)

OBJECTIVE: Use new/advanced electrolytes in ECM technology to address (and hopefully achieve) significantly increased material removal rates, increased precision, improved finish rates, lower power consumption, improved environmental compatibility both in terms of lower health hazards for the ECM operator and reduced waste products while lowering machining costs.

DESCRIPTION: Electrochemical machining (ECM) is a relatively nontraditional fabrication technique based on controlled removal of material by electrolytic dissolution of the work piece. In ECM, the metal removal rate is independent of the relative hardness of the part and the tool. Air-breathing propulsion materials (such as titanium and nickel aluminides) used in Navy aircraft jet engines are becoming harder and more brittle and thus are more difficult to machine using conventional methods. The ECM process, despite its advantages, has had limited applications due, in part, to a lack of to a broad range of electrolytes. Electrolytes currently in use include aqueous solution of salts or strong hydroxides. Electrolytes serve several purposes: (a) carry the electric current between the tool and work piece, (b) heat removal and (c) remove reaction products from the cutting region. Until recently, there has been a lack of scientific understanding of the work piece/electrolyte interface phenomena. Proposals are sought to identify and investigate the use of advanced electrolyte systems (such as, but not limited to, molten salts or molten bases) as they apply to advanced gas turbine propulsion materials. Develop analytical projections for removal rates, precision, surface finish, reduced waste products for engine components made from advanced metal alloys and metal matrix composites.

PHASE I: Identify various electrolytes and indicate physical properties, demonstrate the advantages of each specific electrolyte for feasibility of its removal rate on a selected material, its industrial application and its cost-effective use. Identify associated operation and maintenance requirements. Demonstrate the ECM process using the proposed electrolyte(s) on a specified aircraft gas turbine material.

PHASE II: Develop, build, test and demonstrate a prototype ECM system capable of processing full-scale engine hardware. Demonstrate and optimize system parameters for use on selected advanced metal alloy, ceramic and metal matrix composite turbine components.

PHASE III: Produce a commercial ECM system based on parameters developed in the PHASE II SBIR effort.

COMMERCIAL POTENTIAL: ECM process can be used on both military and commercial aircraft engines as well as manufacturing heavy industrial hardware.

N95-033TITLE: Structural Fatigue Assessment via NDT/I Techniques

OBJECTIVE: The objectives of this effort are to develop Non-Destructive Testing and Inspection techniques and methodologies in order to assess the state of structural fatigue in U.S. Navy aircraft.

DESCRIPTION: The U.S. Navy through its Structural Appraisal of Fatigue Effects (SAFE) program, for over three decades, has led the way by implementing state-of-the-art structural fatigue tracking systems to assess and manage the fatigue damage incurred by every one of its thousands of fixed-wing aircraft. Individual aircraft usage is recorded (with airborne equipment such as Counting Accelerometer Groups and multi-parameter recorders) and analyzed in conjunction with full-scale fatigue test results to determine the fatigue damage. The focus of this SBIR effort is to apply existing, or develop new, NDT/I techniques and methodologies to explore, identify, and seek to both qualitatively and quantitatively assess the state of structural fatigue damage accrued and stored in the material itself.

PHASE I: This phase will primarily focus on the applicability of various NDT/I techniques and methodologies to the structural fatigue assessment concept. Verification testing as required will be limited to coupons. PHASE I will produce a comprehensive report documenting (a) various options and approaches found to be feasible for achieving the goals of this effort, (b) the technical and economic risks associated with these options and approaches, and (c) a ranking of feasible options and approaches with justifying rationale.

PHASE II: After review of the PHASE I report, the Navy will direct the pursuance of selected option(s) and approach(es) in PHASE II. This phase will further develop the Navy-selected option(s) towards (a)

investigating their scope of applicability and limitations for selected, typical structural details of designated Navy aircraft, and (b) establishing NDT/I-based fatigue life tracking parameters and procedures in support of Navy's SAFE program.

PHASE III: Upon a successful PHASE II completion, Navy-funded PHASE III effort is anticipated for the transitioning of the structural fatigue assessment NDT/I methodologies for utilization assessment with regards to the SAFE, SLAP (Service Life Assessment Program) and SLEP (Service Life Extension Program) elements of the ASLS (Aircraft Structural Life Surveillance) program.

COMMERCIAL POTENTIAL: The effort is inherently extendable for commercial application, safety and success.

N95-034TITLE: Durability Modeling of Fiber Reinforced Ceramic Matrix Composites

OBJECTIVE: Develop a methodology for predicting the durability of ceramic matrix composite materials and structures under the thermal, mechanical and environmental conditions expected in Naval aircraft.

DESCRIPTION: Ceramic matrix composites (CMCs) are a promising class of materials that can dramatically increase the thrust-to-weight ratio of the future Navy aircraft. However, the operating environment for Navy aircraft is very harsh and severe. Current development work shows that the CMCs are susceptible to hot corrosion attack. Near term applications for CMCs are in Exhaust components which operate in the hot corrosion regime.
The successful use of CMCs in man-rated Navy aircraft engines requires that the factors contributing to material degradation be recognized. Methods are required whereby these factors can be accounted for during the design and life management of these CMC components. The key issue is life prediction - in this case a model is needed for estimating the influence of operating environment on expected life of CMC components. Hot corrosion can significantly reduce the life of a CMC part. A durability model could also provide guidance to researchers for improving CMC environmental resistance (i.e., effect of coatings, matrix modification, etc.). The current life assessment methodology is based primarily on a limited set of coupon tests and full-scale engine tests. However, the development of a full data-base will be expensive, and time-consuming. A more cost-effective approach is to develop a predictive model for material durability based on a knowledge of the active degradation mechanisms of the constituent materials and their effects on the overall behavior of CMCs.

PHASE I: Provide a feasibility study on developing a durability model for a leading candidate CMC system such as SiC/C composites. The thermal degradation mechanism of the constituents (fiber, matrix, and interface) will first be identified based on the existing data base. The impact of each individual thermal degradation effect (e.g., fiber instability and oxidation of fiber, matrix and interface) on the overall composite performance will be formulated into individual thermal models with additional consideration of thermal cycling, and non-steady state thermal profiles. A micromechanics approach will then be used to integrate individual models into a combined thermal effect model. This model will illustrate property variation as a function of time, temperature, location, stress and environment.

PHASE II: Develop a full scale CMC durability model applicable to all the leading candidate CMC systems (e.g. SiC/SiC, SiC/glass-ceramics, SiC/Si-O-N-C) and validate model by an experimental test matrix. In addition to thermal degradation, corrosion/erosion degradation, mechanical degradation (such as creep, relaxation and damage), coating substrate interactions, local versus global coating failures will be included in the final model. Typical laminate configuration, thermal cycle and environment expected for applications, such as exhaust flap and seal will be used to demonstrate the model.

PHASE III: Transition the CMC durability model developed in PHASE II to Navy Laboratories and to engine manufacturers. This CMC durability model will enable Navy laboratories to establish a new and unique capability in predicting life cycle performance of CMC materials proposed for various high temperature propulsion applications. Engine manufacturers will also benefit from this model for screening CMC materials for engine components.

COMMERCIAL POTENTIAL: Design methodology developed under this effort will enable CMCs to be applied to gas turbine engines that are operated in a marine environment. These include gas turbine generators stationed along coastal areas and generators on commercial ships and commercial airline transport aircraft engines.

N95-035TITLE: Acoustic Sensors Used for Gearbox Vibration Monitoring and Diagnostics

OBJECTIVE: Gearbox vibration monitoring and diagnostics has been traditionally accomplished using accelerometers as vibration sensors. Acoustic sensors would offer advantages over current hard mounted and location specific vibration accelerometers in use today. This project would demonstrate the performance, effectiveness and relative benefits of acoustic sensor technology used for gearbox vibration monitoring and diagnostics compared to that provided by vibration accelerometers.

DESCRIPTION: Both fixed wing aircraft and helicopters use vibration accelerometers as sensor inputs to support various vibration monitoring and diagnostics systems for maintenance troubleshooting. Commercial helicopter manufactures are now implementing Helicopter Usage Monitoring Systems (HUMS) that depend heavily on vibration accelerometer sensors for gearbox monitoring. The use of acoustic sensors instead of the current vibration accelerometers could offer some specific advantages for all these applications. The project would investigate, define, and quantify the specific capabilities and advantages of acoustic sensors used for gearbox vibration monitoring.

PHASE I: Define requirements for system and demonstrate, in principle, the concept of acoustic sensor based vibration monitoring.

PHASE II: Acquire and analyze vibration data using an acoustic sensor based vibration monitoring system, real-time during gearbox seeded fault tests. Compare results with those achieved using the standard vibration accelerometers. Report on evaluation results.

PHASE III: Define and procure a fully integrated acoustic sensor driven gearbox vibration monitoring system for demonstration test on a SH-60 aircraft.

COMMERCIAL POTENTIAL: Application for both military and commercial aircraft use.

N95-036TITLE: Advanced Turbine Exhaust Particulate Measurement System

OBJECTIVE: Develop an advanced, non-intrusive instrumentation system for the measurement of turbine engine exhaust particulates.

DESCRIPTION: The need to measure gas turbine exhaust particulates is important to naval aviation in two respects. First, increasing environmental regulations, such as the Clean Air Act, are making it more important to know and be able to assess turbine engine exhaust emissions. As the regulations become more stringent, they may affect the way the Navy currently operates and tests aircraft engines. The ability to measure particulates will assist in the assessment of the impact that current and future Navy aircraft engines will have on air quality. The ability to predict emissions will allow the Navy to tailor operations and/or testing such that environmental impact will be minimized. Secondly, exhaust particulates are directly related to plume visibility and therefore aircraft survivability. By knowing the size, number and distribution of the exhaust particulates, a good estimate of plume visibility can be made. Current particulate measurement techniques require direct sampling from the exhaust plume and are not very accurate. A non-intrusive system with the ability to accurately measure particulates under 0.02 micrometers in size and their distribution will allow better assessment of engine exhaust in a wide range of situations, such as on the flight line or in a test cell.

PHASE I: Conduct a 6 month study to assess the ability to accurately measure engine exhaust particulates in a laboratory setting. Document findings in a final report.

PHASE II: Further develop the instrumentation system such that measurements can be made in the field with a minimum of special set-up and support equipment.

PHASE III: The system should be developed into a stand-alone, portable system capable of taking measurements in a wide variety of situations.

COMMERCIAL POTENTIAL: The measurement system would have application to engine and aircraft manufactures and the power generation industry.

N95-037TITLE: Engine Composite Blade and Vane Repair

OBJECTIVE: Develop a suitable repair process/equipment for engine foreign object damage (FOD) to composite blades and vanes.

DESCRIPTION: Composite materials are being applied throughout airframe structures to: reduce weight, increase strength, and increase corrosion resistance. The maintenance community was not prepared to provide the required support for these composite material applications. Composites are now being developed for applications to naval aircraft propulsion systems. One of the more near-term applications of this technology will be to use Organic Matrix Composites (OMC) and Metal Matrix Composites (MMC) to cold section blades and vanes. This area of the engine is subject to a great deal of repair actions resulting from FOD. With current metal blades, FOD is repaired through blending. Composites can not be blended by means of conventional techniques. A repair and an inspection/validation technique must be developed to meet this critical fleet need.

PHASE I: Investigate present repair methods for composites on aircraft structures. Characterize potential cold section composite applications for blade/vanes/ Assess present FOD repair limits. Define potential repair techniques/equipment (i.e., blend, tip grind, patch/fill repair, etc.) and their limits for composites with traditional and advanced blade configurations (i.e., hollow, 3-D, etc.). Also define an inspection process to validate the integrity of the repair. These new techniques should provide repair capability to help maintain current engine availability levels and have both I-level and depot level applicability. Document findings in a final report. The contractor and the government shall agree upon which repair concepts will be developed in PHASE II.

PHASE II: Define specific procedures and develop prototype equipment to perform the required FOD repairs/inspection. Perform repair procedures on coupon specimens and verify structural integrity using these new procedures. Obtain a sample of specimens requiring a FOD-type repair and execute the series of techniques developed. Analyze results. Document findings in a detailed final report.

PHASE III: Based on the results of PHASE II, further develop this capability for actual fleet application.

COMMERCIAL POTENTIAL: Composite blade/vanes will be transitioned to commercial engines, therefore this effort will be directly applicable to the commercial sector.

N95-038TITLE: Advanced Automatic Test System (ATS) Resources

OBJECTIVE: Investigate the feasibility of using a common set of ATS resources to determine ATS architecture suitability, capture test requirements information for test program sets (TPS) generation, and meet the requirements for high mobility/inter-operability to support rapid action force deployment operations.

DESCRIPTION: Individual service components currently use unique, parametric-driven data systems to determine ATS architecture suitability requirements for weapon system support. Given the current ATS Investment Strategy to leverage ATS investments across DOD components, there is an increasing need for a common software tool to improve the selection, programming, enhancement and cost effective application of common ATS components. In addition, TPS development continues to be an exceedingly high cost/labor intensive effort and the evolving defense environment continues to demand high mobility ATS. This effort will investigate the feasibility of increased commonality and automation to improve weapon system support and reduce life cycle support costs.

PHASE I: Provide a feasibility study which determines the most appropriate design architecture and computer-aided software engineering (CASE) methodologies to capture test requirements information and accomplish ATS requirements determination analysis, TPS retargeting, and meet the demand for high mobility ATS support. The proposed approach should be a modular, open architecture design to facilitate upgrades, integration and inter-operability with designated common ATS resources.

PHASE II: Based on the successful completion of PHASE I, develop, test and operationally demonstrate the design architecture formulated under PHASE I SBIR effort.

PHASE III: Produce the core software/hardware technologies demonstrated in the PHASE II effort.

COMMERCIAL POTENTIAL: New tools/methodology can be used in a wide range of aerospace, commercial aviation and other commercial sectors.

N95-039TITLE: Automated Composite Scarfing/Step Machining Apparatus for Curved Structures

OBJECTIVE: Design, develop, and fabricate an automated scarfing apparatus for repair of curved composite structures.

DESCRIPTION: Typically the contours of composite aircraft structures are complex in that the surface contains curvature in two planes. Currently available equipment is unsuited for the required tasks of scarfing the laminate to produce a well tapered, bounded repair joint. A device is needed which will adapt to this complex surface. This device should be capable of machining the laminate to a predetermined scarf angle and shape.

PHASE I: During PHASE I of this effort, deficiencies with present equipment will be investigated and a preliminary design concept developed and documented in a final report.

PHASE II: Additional development, fabrication and testing of this equipment will be performed in PHASE II.

PHASE III: Upon successful completion of PHASE II, produce the equipment for commercialization.

COMMERCIAL POTENTIAL: Use of composite materials in the commercial markets is vastly expanding. Apparatus developed under this SBIR has direct application to composite used in aircraft and auto industries.

PRODUCT AREA: Weapon Systems

N95-040TITLE: Weapon Systems Improvements

OBJECTIVE: To improve weapon systems.

DESCRIPTION: The Navy requires improved weapon systems that must operate in the unique carrier environment, which is characterized by salt spray, ships' exhaust gases, intense electromagnetic fields, high (but not low) climatic temperatures, constant high wind and catapult takeoff/arrested landing. They must also be completely self-contained because on a carrier there is no room for weapons over 180 inches long, weapon maintenance, special purpose weapons, fragile weapons, unsafe weapons, special purpose pods, etc. Improvements may include reduce cost, precision targeting of targets in clutter, highly agile airframes, off axis targeting, real time precision strike and battle damage assessment, increased probability of kill warheads, automatic target recognition capability, enhanced adverse weather capability and reduced launch constraints. These improvements support Joint Strike, Air Superiority, and Joint Littoral missions.
To meet these goals the Navy is looking for innovative solutions which promise measurable improvements in any (or all) of the above areas. The Navy will provide a minimum of two awards from quality proposals from the total proposals received from this topic:

PHASE I: Show feasibility of the concept.
PHASE II: Demonstrate the product.
PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: The technologies developed should have applicability to the civilian market.

N95-041TITLE: Sensitive Uncooled Micromechanical IR Detector

OBJECTIVE: To decrease the cost, complexity and weight of sensitive IR detectors.

DESCRIPTION: Sensitive infrared detectors must be cooled and this requirements adds considerable cost, complexity and weights to infrared systems. If sensitive uncooled detectors could be developed, the number of applications both military and commercial would increase significantly. The recent development of a micromechanical calorimeter has shown the possibility of using this type of technology as a sensitive uncooled infrared detector.

PHASE I: Provide a feasibility study to determine the possibility of using micromechanical devices as uncooled IR detectors. This study should identify and analyze the major problem areas associated with this technology.

PHASE II: Develop and demonstrate a prototype infrared detector and show haw the major problems identified in PHASE I were approached.

PHASE III: Produce the infrared detector.

COMMERCIAL POTENTIAL: This innovation has potential to decrease cost of this technology used in infrared imaging and diagnostics.

N95-042TITLE:Environmentally-Durable, Electrically-Conductive Coatings for High Speed Aircraft Windows and Missile Domes

OBJECTIVE: Erosion and thermal-shock resistant, electrically-conductive, optical coatings for MWIR (3 to 5 microns) and/or LWIR (8 to 12 microns) high-speed missile domes and aircraft windows.

DESCRIPTION: Fabricating adherent coatings that can endure severe environments and provide the necessary elector-topical performance is recognized as a major problem in commercial and military applications. For

example, advanced dome materials like sapphire will need further processing and/or special conductive coatings to meet anticipated high-speed missile requirements. current RF/EMI shielding and mitigation techniques have limited success. Conventional, conductive metal mesh structures on external surfaces reduce the RF signal but are mechanically soft and easily damaged. surface-doped semiconductors such as gallium arsenide have optical absorption and emission problems. Durable, adherent, electrically-conductive coatings are needed.

PHASE I: Identify promising materials and coatings processes. Fabricate witness samples of the most promising materials for preliminary characterization of elector-optic performance and evaluation of erosion-resistance.

PHASE II: Demonstrate a cost effective, large area, uniform coating process for simple and complex shapes. Provide samples for validation testing of elector-optic performance and impact resistance.

PHASE III: Production capability for depositing electrically-conductive, durable, optical coatings on missile domes and aircraft windows.

COMMERCIAL POTENTIAL: Similar technology is required for optics, sensors, and photovoltaic arrays on commercial satellites where electrical charging and space-debris/micrometeroid-impact damage severely limit the useful life-cycle. Durable coatings are needed for fiber optic sensors used in severe chemical environments such as automobile and industrial pollution monitors. Electrically-conductive, durable coatings could be used to provide lightweight EMI shielding in many commercial products where electronic noise is a problem.

N95-043TITLE: Wavelet Transforms in Electronic Warfare (EW) Signal Processing

OBJECTIVE: Develop Wavelet Analysis as a new approach to Modulation On Pulse (MOP) processor capabilities and significantly enhance EW System identification.

DESCRIPTION: EW System Emitter ID is currently performed using classical emitter parameters. In addition, MOP is also used particularly in problems involving the following conditions:

1. Emitters with similar parameters
2. Emitter parameters with time variation
3. Signal multipath environments
4. Other real world environments.

The use of MOP signals have added significant performance to ID results and Wavelet processes promise to be ideally suited to these signals. This method is capable of giving signal information in both the time and frequency domain.

PHASE I: Conduct a 6 month study to assess the Wavelet Transform approach to give increased precision to radar system identification by characteristic MOP. The detection ability will be compared with that using the Fourier Transform. Document findings in a final report.

PHASE II: A description of the processing of true raw data in a hardware-software system will be given.

PHASE III: Transition to a Navy airborne EW system.

COMMERCIAL POTENTIAL: The technology developed here has application in the private sector in the analysis of cardiology signals, in compacting TV data, and GPS.

N95-044TITLE: Increasing Frequency Coverage Of High Temperature Superconducting Antennas for VHF/UHF Applications

OBJECTIVE: Increase the frequency coverage of high temperature superconducting (HTS) antennas in the VHF/UHF frequency bands.

DESCRIPTION: The Navy's current interest in the VHF/UHF frequency bands focuses on antiradiation missile (ARM) seekers, air-intercept missile (AIM) seekers, communication data links for aircraft, weapon, and submarine applications. The available antenna aperture for these platforms is severely limited as compared to the operating wavelength. High temperature superconducting antennas and superdirecting arrays of HTS antennas offer the

potential for increased directivity and efficiency on small platforms. However, these improvements are gained at the expense of instantaneous bandwidth. Therefore, before the advantage of HTS antennas can be realized in these Navy systems methods for increasing the frequency coverage of electrically small HTS antennas need to be developed.

PHASE I: Identify and compare potential methods for increasing the frequency coverage of electrically small HTS antennas. Provide a feasibility study which quantifies the increase in frequency coverage as well as potential reductions in overall directivity and efficiency, increases in size, weight and volume effects on pattern fidelity. Compatibility with HTS materials processing and methods of cryogenic cooling should also be examined.

PHASE II: Develop, test and demonstrate an HTS electrically small antenna element with enhance frequency coverage using one of the methods identified in PHASE I.

PHASE III: Using HTS electrically small antenna element with enhanced frequency coverage developed in PHASE II, develop and test an array for limited aperture platforms.

COMMERCIAL POTENTIAL: Commercial applications for compact arrays of HTS VHF/UHF antennas include global communication systems.

N95-045TITLE: GPS CCM Improvements

OBJECTIVE: Improve air-to-surface weapon GPS jamming resistance at a range of 8 nm or greater.

DESCRIPTION: The Navy is currently developing weapons that rely on GPS data for target location and as an aid to INS guidance to the target. This SIR project will improve the weapon's resistance to jamming until its terminal seeker takes over the guidance function.

PHASE I: Perform a feasibility study examining new technologies in antenna/receiver electronics, improvements in data processing, and more efficient algorithms to determine the cost effectiveness of improving GPS jam resistance for precision guided munitions.

PHASE II: Develop and demonstrate the proposed improvement. Perform a production cost estimate.

PHASE III: Package improvements into a missile compatible size. Perform a flight demonstration on a transition candidate, such a JSOW P3I.

COMMERCIAL POTENTIAL: Anti-terrorist protection in commercial air applications.

N95-046TITLE: GPS Telemetry Transmitter

OBJECTIVE: Augment an existing telemetry (TM) transmitter with a Global Positioning System (GPS) receiver. The resultant transmitter will have the ability to transmit GPS-based Time-Space-Position information (TSPI) on a subcarrier of the normal TM data stream. The augmented transmitter will feature an output port so that the digital GPS data can be directed into the digital data stream. This augmentation shall not disable any of the current TM transmitter's capabilities and shall preserve the exact form factor.

DESCRIPTION: The missiles of the last 20 years have all been fitted wit telemetry packs that bring needed information down to range personnel for further development or t\for test and evaluation. These telemetry packs have TM transmitters as subsystems. within. The requirement is to develop a TM transmitter that has its current capabilities and will have GPS embedded within to be sent down in one of two ways:

1. Via standard TM channel
2. Via sub-carrier in the TM frequency

The GPS information would provide tracking information that would meet missile test requirements.

PHASE I: Identify components and interfaces of the elements of TM transmitters to meet the above needs.

PHASE II: Design, fabricate and test a breadboard design of a GPS TM transmitter including GPS antenna on a missile.

PHASE III: Design fabricate, and test five prototype TM transmitter and document the design for transition into production program.

COMMERCIAL POTENTIAL: The technology has application in the private sector where small GPS sensors are needed. When interfaced with new or existing communication links, this technology would provide long distance, precise position information to central control centers on aircraft and commercial land vehicles for many functions including: emergency search and rescue location, crash location, and traffic control.

N95-047TITLE: Arrays of Conformal Waveguide

OBJECTIVE: Develop a low cost accurate array of conformal ridge waveguides.

DESCRIPTION: There is an immediate need for a low cost accurate, compact planar antenna array and the required circuitry to be applied to fuse and seeker antennas. This technology can also be used to construct complex waveguide circuits. An example of the fuse antenna would be for an air-to-air guided missile. Most fuse antennas are mounted on the sides of the missile and have an rectangular cross section. This reduces the antennas performance and takes up valuable volume in the missile. This technology can produce a low cost and high performance fuse antenna that conforms to the missile outer skin resulting in better electronic counter-countermeasure (ECCM) performance, lower sidelobe levels, lower cost, and lower volume.

PHASE I: Investigate the feasibility of constructing an array of conformal ridge waveguides side by side. The development will be done for the array of two waveguides.

PHASE II: Develop a prototype systems to demonstrate the array of multiple side by side waveguides performance. The waveguide array is an antenna system and its associated circuitry.

PHASE III: Integrate a prototype system into an actual air-to-air missile.

COMMERCIAL POTENTIAL: The commercial need for this technology is in the area of Direct Broadcast Satellite (DBS) receiving antenna and collision avoidance car antennas. Low cost and high volume is the greatest concern in these areas. The DBS antenna and the combining circuitry can be constructed from one sheet. The resulting antenna and circuit is on the same plane resulting in a high performance, low cost, and very producible product. An array of antennas with different RF views of the road in front can also be constructed using this approach.

MARINE CORPS REQUIREMENTS

N95-048TITLE: Systems and Technologies for Future Amphibious Warfare

OBJECTIVE: To enhance Marine Corp's future amphibious warfare capabilities the following top level needs have be addressed; Surface Mobility Technology, Mine Detection Technology, Land Mine Countermeasures Technology, MARFOR C4I Technology, MAGTF Survivability Technology, Advanced Amphibious Logistics Technology, Targeting Sensors, Weaponry Technology.

DESCRIPTION: The Marine Corps is seeking new, innovative ideas in technologies or systems concepts that support the Marine Corps amphibious mission. A minimum of five awards will be made under this topic for quality proposals. Proposals may be submitted that fit the top level needs or specific subject areas and should be titled to allow identification by top level need or specific subject area title:

A. Top level needs

1. Surface Mobility Technology - Technologies which increase the overall capabilities of Marine Corps vehicles and surface mobility.
2. Mine Detection Technology - Capability of remotely detecting all types of land mines during operations from the very shallow water/surf zone to inland battlefields. Need is for real time, day/night detection and surveillance capability to remotely detect current and future mine threats.
3. Land Mine Countermeasures Technology - Technology for rapid neutralization of mines, mine fields, booby traps and other obstacles in the surface zone and ashore to include advance threat wide area mines.

4. MARFOR C4I Technology - Innovative technologies in electronics and information management processing to enhance and support Marine Force Command, Control, Communications, Computers and Intelligence to include revolutionary materials for advanced stored energy concepts.

5. MAGTF Survivability Technology - Technology which increases the survivability of Marine Corps personnel and equipment assets in all levels of combat and physical environments for the Marine Air-Ground Task Force (MAGTF)

6. Advanced Amphibious Logistics Technology - Logistics technologies to enhance and support Operational Maneuver From the Sea (OMFTS) concepts or improve or enhance all phases of logistics for Marine Corps amphibious operations for Combat Service Support of maneuver forces from minimum 60 miles at sea to up to 40 miles inland with no beach support area established.

7. Targeting Sensors - Innovative sensor technologies that enhance the engagement performance of direct and indirect fire weapons for the conduct of maneuver warfare by tactical ground commanders such as but not limited to early target detection, increased first round hit probability and successful Identification Friend or Foe (IFF) with passive/low signature methods.

8. Weaponry Technology - Technologies that focus on increasing the lethality and operational effectiveness of combat elements of the MAGTF such as but not limited to innovative technology for mounted mortars, enhanced target designation
and volumetric lethality against area targets and advanced energetic material for multiple munitions use with significant weight reduction, but no loss of performance in company mortar
system.

B. Specific Subjects

1. Wavelength-Selective Solar-Blind Filters - Development of wavelength-selective filters in the solar blind ultraviolet (UV) region.

2. GPS/GIS Based Engineering Reconnaissance in Support of Virtual Reality Presentations - Provide an Earth satellite based engineering reconnaissance data acquisition system that will support a virtual reality system for use by field commanders in making site selection decisions using the Global Positioning System (GPS) and the Global Information System (GIS).

3. Remote Display and Interrogator - The development of a wireless interrogator, which can be used in the field to obtain logistics data such as with a wireless helmet mounted device, which provides real time virtual supply information.

4. Container manifesting system - Development of an RF container manifesting system with a Manifest Tag and an RF label.

5. Light Weight Shaped Charge Case - Development of a shaped charge case that weighs significantly less than the traditionally used metallic cases with performance comparable to metallic case shaped charges.

6. Next Generation Batch Liquid Containers - Development of batch liquid containers, which are multipurpose, ballistic resistant and fire retardant.

7. Next Generation Field Transportable Liquid Transfer System - Develop fuel efficient, field transportable liquid transfer systems, which are integral to the container they are filling/draining.

PHASE I: At the end of a six months effort, work should have demonstrated the feasibility of a systems concept or technology, identified critical issues required to transition into the Marine Corps acquisition system, identified goals for systems performance, outlined the current technology maturity, provide evidence that the scientific principles on which the technology is based are sound and justify further work, identify the work necessary in a Phase II effort necessary to demonstrate technical feasibility and increase the potential of the technology or systems concept to transition in Phase III to public and private applications with an exploration of dual use potential.

PHASE II: At the end of a two year effort, the technology or systems concept must have been developed enough to bring subsystems or technologies for transition to maturity, completed sufficient work to enable the technology to transition to an active development program, or become the basis for an operation requirement and acquisition of the technology or subsystem for Marine Corps applications and or other service applications as well as private sector commercialization.

PHASE III: Phase III must include both public and private sector commercialization with a goal to reduce acquisition cost for Marine Corps through other service/government agency applications, as well as private sector

commercialization. The ability to successfully transition in Phase III will be critical both in Phase I selection and Phase II approval.

NAVAL SEA REQUIREMENTS

In general Naval Sea Topics are more specific in their description. Content of Proposals responding to these topics shall be directly relevant to the topic title and topic objective and shall address major issues cited in the topic description section(s).

The following three topics solicit Phase I SBIR Proposals for the purpose of improving US Navy control of the air battlespace above land and sea as described. Theater Air Defense neutralizes enemy offensive projection of power in littoral regions with minimum casualties. The following technologies support these capabilities: missiles, surveillance sensors, and their signal processing; intelligence gathering; command and control; communication and other weapons for attacking enemy air targets.

N95-049TITLE: Develop Naval Gunfire Defense against Anti-Ship Missiles

OBJECTIVE: The objective of this effort is to permanently defeat modern anti-ship Missiles by rounds or payloads that are fired from the Navy's standard five-inch gun. Existing active or passive countermeasures can temporarily distract or divert anti-ship missiles from their original target(s) and these capabilities are excluded from our objective. Although munitions employing thermochemical means have an expected high probability of success, and are preferred, other means may be proposed subject to the following requirements or restrictions.

DESCRIPTION: Relevant proposals shall provide an effective means to permanently defeat or kill anti-ship missile; the means will prevent the missile from re-engaging any Target. The proposed means should: Immediately cause mechanical damage/erosion of the missile structure or otherwise immediately defeat the missile's ability to engage the target(s); provide uncompromised use of the Navy five-inch gun; and provide new or modified five-inch munitions effective against modern anti-ship missiles.

PHASE I: Relevant Phase I (concept definition) proposals shall: develop the design concept and physical characteristics and performance objectives of the munitions/disclose the aforementioned; provide calculations of kill probability as a function of the engagement geometries, timing/fusing, and the munitions expansion characteristics; and provide a demonstration of the concept in a ground test of a prototype munitions under static conditions.

PHASE II: Relevant Phase II (concept demonstration) proposals shall: conduct a twenty-four month effort including design and test of the munitions; conduct a critical design review of the munitions; effect the development of the munitions and perform field experiments against typical IR and RF seekers; submit the munitions design disclosure data for approval; and prepare test plans and test reports and execute all tests required.

PHASE III: Relevant Phase III (concept implementation) proposals shall: transition the technique to a government owned full scale item development and limited production. The sensor blinding metal vapor canisters will be tested and compared against other competing concepts.

COMMERCIAL POTENTIAL: The technology has applications in the private sector for metal coatings of wider availability and lower cost. Refractory metal coatings are needed in high temperature commercial processes and for oxidation (erosion) protection rocket nozzles.

N95-050TITLE: Simulation of Optical Environmental Effects

OBJECTIVE: The objective of this effort is to develop techniques for the convenient simulation of optical environmental effects along the optical propagation path in Navy optical systems. Many Navy optical systems employed in detection, recognition, tracking, threat categorization, or countermeasures are sensitive to environmental effects along their optical line-of-sight.

DESCRIPTION: Relevant proposals shall provide an effective means to simulate optical environmental effects known to degrade the optical line-of-sight employed in Navy optical systems. These environmental effects, from whatever source(s), introduce distortion(s) into the propagating optical wave which observationally leads to effects such as scintillation, signal fading, beam steering, and image wander and distortions. These effects can inhibit the effective operation of an optical system resulting in reduced performance, at times, to unacceptable levels. Over the past several years, the Navy has developed and implemented a number of tools including laboratory hardware-in-the-loop simulations to evaluate the performance of various optical systems and techniques. To quantify the effects of the optical environment, methods for adding these effects to the optical system performance test are desired. An acceptable simulation must be well characterized, controllable, repeatable, and traceable to conditions encountered in field tests and demonstrations.

PHASE I: Evaluate various methods for simulating optical environmental effects. Select and recommend techniques which best meets Navy requirements for laboratory hardware-in-the-loop simulators.

PHASE II: Design, fabricate, and test an optical environmental effects simulator. Install equipment on a Navy hardware-in-the-loop simulator.

PHASE III: Multiple Government agencies develop, fabricate, and utilize optical systems which operate with turbulent paths. The availability of turbulence simulation hardware would be of value for the convenient testing of these systems. Similar uses on the commercial marketplace can also be identified.

COMMERCIAL POTENTIAL: The technology developed in this project could have application for the testing of commercial optical systems.

N95-051TITLE: High Repetition Rate Mid-Infrared Lasers

OBJECTIVE: The objective of this effort is to develop a high repetition rate, high power, solid state laser to efficiently generate coherent energy in tunable wavelengths in the 3-5 micron range. The laser must be rugged and reliable and capable of being used in field testing.

DESCRIPTION: Relevant proposals shall provide high repetition rate, >30W output power lasers in the 3-5 micron range to support ongoing development of electro-optical systems. Electro-optical systems support improvement of capabilities in missile defense and surveillance sensors.

PHASE I: Demonstrate the feasibility of the proposed concept to improve power scaling and/or decrease cost of such lasers. A design concept shall be developed for the 30W output power laser.

PHASE II: Develop, fabricate, test and demonstrate a prototype high power mid-infrared laser suitable for overwater testing at a range. Laser tunability shall be demonstrated to be within atmospheric transmission subwindows.

PHASE III: The technology will be transitioned to a government owned test facility.

COMMERCIAL POTENTIAL: Other possible applications include the use of such a laser source for drug interdiction and oil exploration for sensing hydrocarbon molecules. The 1 micron diode pumped laser can be used in the semiconductor processing equipment market with a $1 billion sales potential.

The following six topics relate to submarines and requirements necessary to enable them to function effectively in the open ocean.

N95-052TITLE: Combat System Interface Simulation/Stimulation

OBJECTIVE: The objective of this topic is to develop innovative techniques for simulating/stimulating the signals and controls at the interfaces to a combat system.

DESCRIPTION: Combat systems interface to many sensors, users and other subsystems in an operational environment. In a submarine combat system, these include acoustic and non-acoustic sensors, navigation systems,

communications systems, weapon systems, and combat system operators. During development and testing of the combat system, and during operator training, it is often impractical to have the entire interfacing environment available for interface stimulation and response. The offeror should propose innovative techniques for simulating the combat system interfaces and the responses that are expected during all states and phases of operation.

PHASE I: Demonstrate concept feasibility by developing a simulation architecture that will provide combat system interface stimulation and realistic responses without the need for the actual sensors and associated subsystems.

PHASE II: Demonstrate feasibility of the proposed conceptual architecture by developing a prototype combat system simulation/stimulation facility that provides realistic stimulation and response for a selected subset of the combat system interfaces.

PHASE III: Produce a complete combat system interface simulation/stimulation facility that can be used to provide realistic inputs and responses for use during system development, integration, test, and operator training.

COMMERCIAL POTENTIAL: This technology can be used for interface simulation and stimulation in large systems, as might be found in a ship or aircraft control system.

N95-053TITLE: Submarine Portable Launch System

OBJECTIVE: The objective of this topic is to develop a small and portable submarine launch system from Commercial Off the Shelf (COTS) components system for use with weapons and other vehicles launched through submarine torpedo tubes.

DESCRIPTION: Currently SSN platforms and combat control systems are required to support a variety of missions and on-going weapon development/evaluation activities. The uniqueness of these multi-mission submarine warfare systems requires that all platforms, support all weapons/mines/vehicles at all times may be unrealistic. A portable launch system that implements a COTS based "Open System Architecture (OSA)" will provide a low cost ability to tailor the launch panel for specific applications in submarine ASW, Surveillance and other missions. This approach can alleviate the time and costs of CCS integration and provide the flexibility necessary to expedite submarine participation in new mission areas or evaluation of new weapons/vehicles. Submarine deployment of mines is a very good example of how this system can be applied.

PHASE I: Develop a generic concept through analysis of submarine mission areas where torpedo tube launched weapons/vehicles are appropriate for a stand alone portable launch system and develop a generic design concept which defines the system functional requirements and proposed COTS implementation for the portable launch system.

PHASE II: Develop Advanced Development Model to demonstrate concept/design.

PHASE III: Engineering Development or Production, if appropriate

COMMERCIAL POTENTIAL: Use of an Open COTS based design will provide the commercial sector with miniaturized analog to digital open system interfaces and multi-dimensional human system interfaces for remote operations are have potentially applicable to commercial industry in undersea exploration or robotics.

N95-054TITLE: Submarine Low Cost Littoral Water Sonar Passive Localization System

OBJECTIVE: The objective of this topic is to develop a small, low cost, High Frequency Towed Array (HFTA) sonar system to be utilized for passive localization applicable to shallow water (littoral) areas.

DESCRIPTION: The current tactical towed array sonar systems developed by the Navy were designed to meet the anticipated threat expected to be encountered in open ocean operational areas. As a result, the frequency band covered was relatively low in response to the long range propagation characteristics of the ocean and the dominant acoustic energy emanating from the targets historically seen in these environments. A HFTA provides the potential for substantial improvement in detection capability in higher frequency bands, through isolation from hull generated noise mechanisms and provide equivalent classification capabilities as existing towed array systems in shallow waters - further, the spatial separation of the towed array from the hull array also provides a cost effective capability for passive localization when used in conjunction with the hull mounted array systems. Additionally, the HFTA

coverage of the active sonar band will provide a separate bi-static or multi-static receiver for active sonar operations.

PHASE I: Analyze littoral water mission area where use of this type of sensor system would be appropriate. Develop a generic design concept which defines the system functional requirements and models the system for ability to transmit the large bandwidth of required data from the array to the submarine.

PHASE II: Develop Advanced Development Model to demonstrate concept/design.

PHASE III: Engineering Development or Production, if appropriate.

COMMERCIAL POTENTIAL: The technology is applicable to locating objects on the ocean bottom.

N95-055TITLE:Development of Adaptive Filtering System to Eliminate CW Interference in Submarine IFM-based Electronic Support Measure (ESM) Systems.

OBJECTIVE: The objective of this topic is to develop a practical adaptive filtering system to replace notch filters in IFM systems.

DESCRIPTION: CW signals can interfere with the performance of ESM systems using IFM-type receivers; in some environments, CW signals can capture the receiver and preclude intercept of pulsed signals. Use of even a few tunable notch filters to exclude CW signals is cumbersome, resulting in signal power, space and cost penalties. Adaptive filtering techniques using advanced correlation devices such as SAWs for automatic exclusion of multiple CW signals in a system would be much simpler than present notch filters.

PHASE I: Design an adaptive filtering system to eliminate CW signals in IFM-based submarine ESM systems. Prepare Phase II Program Plan.

PHASE II: Develop a breadboard adaptive filtering system to replace present notch filters. Integrate with submarine ESM system and demonstrate performance in CW-exclusion in simulated signal environment known to degrade intercept performance.

PHASE III: The adaptive CW filtering system will be transitioned to deployed and future submarine ESM systems, providing superior intercept performance in the presence of interfering CW signals.

COMMERCIAL POTENTIAL: Intercept systems capable of performance in the presence of CW signals will have application to law enforcement systems used in activities such as drug interdiction.

N95-056TITLE: Low Light Level Color Imaging with Image Processing

OBJECTIVE: The objective of this topic is to improve the capabilities of low-light level color imaging using either special image intensification techniques with application specific image processing algorithms, and etc.

DESCRIPTION: Color cameras have shown dramatic improvements in image quality, resolution, and dynamic range. However, very little improvement has been made in the area of image intensification. Under moderate to low light level conditions, these cameras generally perform very poorly. This poor performance has greatly limited the use of color cameras in system that operate in dusk/dawn environments. Because of the obvious advantages of color over monochrome (i.e. realism, better object recognition, submarine navigation, intelligence operation, and etc.), system's with low-light level requirements could be dramatically improved if a color camera could be used in place of the existing monochrome (visible or FLIR) camera. This imagery could then be further improved if real-time application-specific image processing algorithms could be used to reconstruct the imagery and provide good color rendition from the poor raw imagery.

PHASE I: The contractor must develop an image processing system that will provide good color rendition from imagery obtained from intensified and non-intensified color cameras, i.e., from imagery where the light levels vary from 1000 lux to 1E-4 lux. As a minimum, the image processing system should correct the imagery such that one could be able to distinguish common shipboard (military and commercial) lights; i.e., red, white, green, and yellow, given typical commercial (source) luminosities taken at appropriate ranges.

PHASE II: Methodologies used to design and develop this system should include but not be limited by performance trade-off analyses of adaptive image painting and/or image contrast/color stretching of intensified and non-intensified color CCDs, or Silicon Injected Target sensors. Other more exotic designs are also encouraged. Using the chosen design, the contractor will manufacture three systems. All three systems will be provided to the government for further T&E. The contractor will provide monthly technical progress reports and a final comprehensive technical report of Phase II efforts.

COMMERCIAL POTENTIAL: The largest commercial application for this technology would be the camcorder market. The best low-light capability of today's commercial camcorders is about 1 LUX. This still results in snowy video under some typical video recording conditions. In addition, filming in some dusk/dawn conditions and at night is not possible. Improvements in low-light capability would greatly enhance the quality and usefulness of these commercial products.

N95-057TITLE: Innovative Passive Electromagnetic Sensors for Submarines

OBJECTIVE: The objective of this topic is to develop new passive sensors for detection and tracking of aircraft contacts by submarines which utilize existing mast and antenna configurations.

DESCRIPTION: New submarine missions are being developed which will require submarine commanders to operate in littoral waters. These missions require the submarine to monitor the airspace in the operational areas. Many aircraft will be non-emitting and will remain undetected by conventional means such as ESM and IR sensors. New sensors are required that allow a real time picture of the airspace to be maintained passively. These new sensors must be able to use existing submarine antennae for signal reception. It is envisioned a Commercial Off The Shelf (COTS) based system will be able to provide radar-like presentation of the detected and tracked aircraft.

PHASE I: Explore new sensor technologies that provide the submarine with a passive aircraft tracking capability.

PHASE II: Build prototype systems for laboratory and at-sea testing.

PHASE III: Transition prototype test products to production baseline.

COMMERCIAL POTENTIAL: New sensors would be able to provide a backup capability to existing air traffic control systems at major airports in the event of their failure. Many small airports do not have radar systems due to the costs involved. These passive sensor systems are envisioned to be low cost and do not require transmitters, allowing many smaller airports to be able to monitor its' air traffic and increasing safety.

The Program Executive Office for Undersea Warfare PEO (USW)) is responsible for managing the acquisition of ASW systems, subsystems, and hardware and software components. Responding to the evolving needs of both the surface and submarine fleets in an era of changing threats and requirements, PEO(USW) works to ensure the maximum tactical advantage is available to the fleet to combat the undersea threat. Tactical areas of interest include: target surveillance; Detection, Classification, and Localization (DCL); data processing and display; weapon control and related computer subsystems; weapons; countermeasures; launchers; unmanned Undersea Vehicles (UUVs); handling and stowage equipment; related communication, command and control; support and training equipment. The PEO(USW) manages the following programs: Lightweight Torpedoes (MK 46 and Mk 50), Heavyweight Torpedoes (Mk 48 and Mk 48 ADCAP); Advanced Torpedo Warhead; Surface Ship ASW Combat System (AN/SQQ-89); Unmanned Undersea Vehicle and Targets; Torpedo defense and countermeasures (Surface Ship and Submarine); Joint US/UK Surface Ship Torpedo Defense; Vertical Launch ASROC; Navy Signal Processors (AN/UYS-1 and UYS-2); Undersea Warfare Advanced Systems and Technology Programs.

N95-058TITLE: Develop an Active Advanced Signal Processing Techniques for Active Sonar Contact Classification

OBJECTIVE: Develop active sonar classification techniques based upon adaptive processing of contact data processed in affordable signal processors.

DESCRIPTION: Innovative solutions using graphical command/control interfaces and state of the art techniques coupled with advanced processing technology are sought which are cost effective and compatible with on board equipment. Sonar performance in shallow water has been demonstrated to have a higher false alarm rate than deep water environments. Signal processing techniques capable of sorting target from non-target are required to successfully operate in these areas. Improvements in shipboard signal processing capabilities using advanced processing technology will make it possible to realize the implementation of computationally intensive processing algorithm which have not been possible in the past. Active classification research efforts to date have identified a number of promising processing techniques to extract the maximum information possible out of an active waveform. We desire to improve classification reliability while reducing the threshold between detection and classification.

Specific examples of advanced processing techniques include the use of time frequency/time scale analysis, programming by pictures, and the use of higher order moments to improve classification. The proposed solution will examine a number of advanced processing techniques which have previously been promising but which have not been affordable because they were computational intensive. Alternatives for time frequency, graph object, and time scale analysis all of which focus on improving their solution of parameters required to correctly classify a target are needed. Higher order moments associated with real world, non-gauss active returns may also improve classification. Fusion of clues extracted by various techniques cited above or others which result from this effort will likely be required. An important aspect of this effort is that algorithms be implemented with ongoing commercial processor advances to insure adaptability and affordability.

PHASE I: Show feasibility of the concept.

PHASE II: Demonstrate the product.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: Expected commercialization include harbor surveillance, navigational and fishing applications, scientific exploration, development of application software.

N95-059TITLE: Develop Adaptive Neural Network Signal Processing

OBJECTIVE: Develop and demonstrate situationally adaptive neural network sonar classification techniques for real time classification, in a high clutter environment of active sonar contacts.

DESCRIPTION: Innovative cost effective solutions are sought that use situationally adaptive neural networks for real time classification that are compatible with existing equipment and are designed to make complete use of Doppler, velocity dynamics, echo shape echo shape moments and other significant target echo features.

A. Rapid detection, classification, and localization (DCL) of targets in shallow water environments is needed to support Navy warfare missions. Due to the time-varying environments and the difficulties associated with obtaining accurate measurements in these environments, it is necessary to consider robust adaptive DCL algorithms. These features seek to insure that accurate measurements, when available, are used to best advantage, and inaccurate measurements are recognized quickly and appropriately discounted before they adversely affect the DCL estimates. Research efforts to date have concentrated on the use of Probabilistic Neural Networks (PNNs) and Back Propagation (BP) neural networks for the classification of signals in spectrograms and classification using active sonar returns.

B. A key consideration is the ability to implement the neural network processing algorithms in NDI/COTS based processors using reasonable computational resources. Offerors shall propose developing a signal processor concept design. Successful design would transition to an operational system upgrade.

PHASE I: Show feasibility of the concept.

PHASE II: Demonstrate the product.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: Expected commercialization includes harbor surveillance, fishing applications and scientific exploration.

N95-060TITLE: Develop Advanced Directed Energy/Blast Warheads for Torpedo Applications

OBJECTIVE: Develop a lightweight torpedo warhead design to provide both ASW (Anti-submarine warfare) and ASUW (Anti-surface warfare) capability with enhanced blast explosive and sub caliber shaped charge liner is desired.

DESCRIPTION: Current lightweight torpedoes are extremely limited in the size and weight available for the warhead and major compromises are made in the torpedo design to ensure a single capability is maximized for the specific weapon. The capability to incorporate advanced blast explosives and an advanced shaped charge linear will be developed. The new system shall be capable of specified performance in certain classified scenarios. This warhead can ultimately be used in the COMMON TORPEDO of the next century. The design of this warhead should have specific cost goals and thresholds in production. The design will ensure that all safety and reliability criteria for ordnance is met and performance in specific scenarios is achieved. Additionally a complete and EPA approved disposal process will be required for the warhead system. Innovative solutions are sought which after examining current technology for packaging, power, and performance provide a design for production implementation.

PHASE I: Show feasibility of the concept.

PHASE II: Demonstrate the product.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: This product would be appreciated for advanced explosive for mining and seismic studies.

N95-061TITLE: Develop Active/Passive Data Fusion Operator Associate

OBJECTIVE: The objective of this topic is to develop a situational assessment tool featuring the fusion of active and passive submarine sensor detection results.

DESCRIPTION: Submarine sonar systems lack effectiveness in shallow water deployments. The dense obstacle environments typical in shallow water impedes the effectiveness of these sonar systems. The association, correlation, and combination of data from multiple sources to achieve a complete assessment of threats in a timely manner is of the utmost importance in this environment. Data fusion enhancements offer the potential for improving the performance of sonar sensors.

This effort will focus on the design, development, and demonstration of a submarine sonar operator aid to assist in the fusion of all acoustic processed information. Offloading the combat control operator of tasks that lend themselves to automation and developing a clear method of presentation are key to this effort. The requirements for specific automation algorithms and operator aids will be defined and a conceptual design developed. Fusion of all simultaneous operating active sonar data (medium and high frequency) will be investigated as well as using the passive sensor data from any array along with any other sources of opportunity. Blending of current MMI designs and computer aided/automated techniques with capabilities supported by ongoing workstation advances will be key concerns of this effort. The requirements for specific automation algorithms and operator aids will be defined and a conceptual design developed. Fusion of all simultaneous operating active sonar data (medium and high frequency) will be investigated as well as using the passive sonar data from any array along with any other sources of opportunity. Blending of current MMT designs and computer aided/automated techniques with capabilities supported by ongoing workstation advances will be key concerns of this effort.

PHASE I: Show feasibility of the concept.

PHASE II: Demonstrate the product.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: Products from this development effort have potential application for harbor surveillance, navigation aids and scientific exploration.

N95-062TITLE: Exploration of Sources of Opportunity for Submarine Sonar Systems

OBJECTIVE: The objective of this topic is to develop a combination of realtime signal processing, tactics and existing sensors that can provide a tactical advantage to a submarine against an unsuspecting target.

DESCRIPTION: By combining signal processing, tactics and existing sensors increased tactical capability for submarines in littoral warfare environments can be achieved. In time critical battle management situations are deployment of an active sonar source has inherit advantages due to its speed of delivery. Other fixed and mobile sources of opportunity already positioned may provide a tactical advantage to submarines against unsuspecting targets. Using planned improvements in shipboard signal processing capabilities combine with recent advances in air deployed active sources (i.e. ; EER and ADLFP), and developing tactics which allow either a submarine or surface vessel to exploit air deployed sources while remaining covert, this potential can be realized.

We intend to develop a wavefront curvature technique to perform source localization on the direct blast. If the transmit waveform is not known, the direct blast will be used to develop a replica of the transmit waveform. Matched filter processing will be use to capture replica as a substitute for the transmit waveform. The directivity index shipboard sensors will have an advantage over air deployed receivers providing improved performance for target persecution. Real time, signal processing which adapts to sources of opportunity will be designed and developed. Tactics to arrive at processing requirements will be examined.

PHASE I: Show feasibility of the concept.

PHASE II: Demonstrate the product.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: Expected commercialization includes harbor surveillance, fishing applications and scientific exploration.

N95-063TITLE:Develop the Dynamic Behavior of a Unmanned Undersea Vehicle (UUV) Surf Zone Vehicle Control

OBJECTIVE: Investigate dynamic behavior of a UUV operating in a Very Shallow Water (VSW) environment in support of amphibious operations and develop suitable control systems.

DESCRIPTION: This topic has direct application to all UUV's which operate in coastal areas. Hydrodynamic models are required to support the development of UUV control systems. Accurate and robust hydrodynamic models are essential for performance prediction of UUV control behavior within the surf zone. The final objective is to determine the optimum vehicle size, range and configuration for employment in the surf zone. Innovative solutions are sought and offers should propose various control system concepts based on results from the hydrodynamic computer models, develop appropriate physical models, and conduct testing to verify designs.

PHASE I: Show feasibility of the concept.

PHASE II: Demonstrate the product.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: Application of this product would provide commercial ROV/UUV's a better ability to bottom map, survey (pipelines, cables, piers, bridges), and perform work (repair, salvage) in high surf zone coastal waters.

The next four topics apply to the Aegis Class of ships. The Aegis Program is responsible for the deign, development, engineering, acquisition, production, and life cycle support of AEGIS cruisers and destroyers including their combat systems. The AEGIS Program is committed to delivering and maintaining reliable, capable, affordable ships to the operational Navy. Since the AEGIS Program has a broad shipbuilding responsibility, it also has a corresponding interest in innovative high payoff technologies to meet its commitments. Technologies contributing to the design and maintenance of capable and affordable anti-air warfare systems are of current interest. Proposals are sought in the following general areas that are particularly applicable to the AEGIS Program:

N95-064TITLE: Radar Simulation

OBJECTIVE: The objective of this topic is to develop a flexible radar simulation for design, analysis and test support of military and civil systems.

DESCRIPTION: The simulation should be block oriented permitting various degrees of subsystem abstraction. Abstraction levels may run from the signal processor bit level to closed form mathematical expressions. Particular attention must be paid to radar environmental factors such as propagation, clutter, and target models. The simulation should run under MS DOS.

PHASE I: Show feasibility of concept. Survey literature and existing simulation technology, and determine if elements of existing technology can be used for a simulation structure and construction of a limited simulation.

PHASE II: Development and evaluation of the full scale simulation with accompanying documentation. The model shall be available for user evaluation and subsequent update prior to delivery.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: Commercial potential exists for radar design, test, and analysis tool development.

N95-065TITLE: Develop Concepts for Delivering Logistic Information

OBJECTIVE: The objective of this topic is to develop an effective, innovative system for delivering digital logistic information to ships. This digital information mimics published maintenance manuals, including both text and images. Dual-use application to any commercial off-site activity requiring extensive logistics information.

DESCRIPTION: Shipboard access to maintenance information is presently restrictive; but maintenance personnel require a single-source response to their inquiry for maintenance information and repair parts; and require each response provide current information in correct format and context. The Navy CALS (Computer Aided Acquisition and Logistics Support) program will replace the present paper logistic documents with digital replications. This requires new system definition and assessment of the impact upon logistic procedures and products, and a transition strategy.

PHASE I: Develop the concepts, define the system, and identify impacts on current procedures and products, and develop a transition and implementation strategy for digital logistic information.

PHASE II: Implement the new system and concepts on a pilot project for selected shipboard systems.

PHASE III: Produce and market the product.

COMMERCIAL POTENTIAL: Any commercial off-site activity requiring immediate access to large amount of technical and logistic information can apply this new concepts (Construction crews, off-shore oil rigs, maintenance/repair work crews).

N95-066TITLE: Semi-Portable Antenna Near-Field Scanner

OBJECTIVE: Develop the concepts and design a low-cost, semi-portable antenna near-field scanner system capable of performing diagnostics and antenna measurements and allowing rapid installation and alignment at various locations to support antenna development or overhaul operations..

DESCRIPTION: In order to rapidly diagnose various antenna performance parameters, a low cost semi-portable near-field scanner is required.

PHASE I: Develop and evaluate one or more designs for the proposed system. The concept design(s) will address, at a minimum, major technical hurdles and their implementation; performance targets including speed and accuracy, and measurement capabilities. A partial implementation of one or more candidate designs will be presented.

PHASE II: Demonstrate the Phase I with a complete prototype system for one of the systems developed and reviewed under Phase I. The system design will be documented for future production, for future installations and use, and for future system enhancements.

PHASE III: Upon successful completion of Phase II, systems would be of immediate benefit to all Navy, DOD or other government installations doing antenna work by providing a quick and effective method of performing antenna measurements and diagnostics.

COMMERCIAL POTENTIAL: The scanner is expected to have immediate benefits for any commercial, university, government or other laboratory which performs measurements of antenna parameters or antenna development work.

N95-067TITLE: Develop Robust Estimation for Target Tracking

OBJECTIVE: Develop a robust estimation techniques/algorithm and verify performance via simulation, that enhances/improves radar tracking filter performance when the system model varies significantly from the design model.

DESCRIPTION: Robust modern control theory has been a topic of research that has received much attention in the past decade. More recently, several advances have been made in robust estimation theory. In cases where a precise model of the system is difficult to obtain or where the disturbances have unknown means and dynamic variations, the robust estimator should demonstrate improved estimation performance. The robust estimation techniques should address the importance/benefits of using weighing filters to model desired tracking performance at the frequencies of interest as well as identify criteria for their selection and design.

PHASE I: Develop technique/algorithm and demonstrate via simulation improved tracking of highly maneuverable targets in a noisy environment.

PHASE II: Develop an optimal filter design and develop real time tracking filter. Demonstrate using recorded radar track data.

PHASE III: Implement real time filter design in a radar tracker. Demonstrate performance against real targets.

COMMERCIAL POTENTIAL: Aircraft multiple targets tracking and control processes. (Air traffic control, airspace monitoring, etc.).