NAVY

Proposal Submission

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of the Chief 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 the Chief of Naval Research
ATTN: Mr. Vincent D. Schaper
Navy SBIR Program Manager
800 North Quincy Street, BCT #1, Room 934
Arlington, VA 22217-5000
(202) 696-4286

The Navy has identified 78 technical topics in addition to the 310 identified in the DoD Program Solicitation 90.1 to which small R&D businesses may respond. A brief description of each topic is included along with the address of each originating office. This information is contained on the ensuing pages.

SBIR proposals shall not be submitted to the above address and must be received by the cognizant activities listed on the following pages in order to be considered during the selection process.

The Navy's mission is to maintain the freedom of the open seas. To that end the Navy employs and maintains air, land and ocean going vehicles and personnel necessary to accomplish this mission. The topics on the following pages provide a portion of problems encountered by the Navy in order to fulfill its mission and are an increase over previous years.

Selection of proposals for funding is based upon technical merit and the evaluation criteria contained in this solicitation document. Because funding is limited the Navy reserves the right to limit the amount of topics funded under any topic and only those topics considered to be of superior quality will be funded.

NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Submitting Proposals on Navy Topics

Phase I proposal (5 copies) should be addressed to:

Administrative
Topic Nos. N90-311 through N90-318

Mail/Handcarry Address	SBIR Contact
Office of Naval Research	Dr. D. Polk
Attn: ONR Code 1131M, Room 607	(202) 696-0283
SBIR Program, Topic No. N90-___	
800 N. Quincy St., BCT #1	
Arlington, VA 22217-5000	

Topic Nos. N90-319 through N90-322

Mail/Handcarry Address	SBIR Contact
Office of Naval Technology	Dr. D. Harry
Attn: ONT Code 20T, Room 502	(202) 696-4453
SBIR Program, Topic No. N90-___	
800 N. Quincy St., BCT #1	
Arlington, VA 22217-5000	

Topic Nos. N90-323 through N90-327

Mail/Handcarry Address	SBIR Contact
Commanding Officer	Ms. Maxine Channon
MCRDAC, SBIR Program, Topic No. N90-___	(703) 640-2761
Amphibious Warfare Technology Directorate	
Quantico, VA 22134-5080	

Topic Nos. N90-328 through N90-360

Mail/Handcarry Address	SBIR Contact
Headquarters, Naval Air Systems Command	Mr. J. Johnson
Department of the Navy	(202) 692-7393
Attn: Code AIR 9303D, SBIR Program, Topic No. N90-___	
Washington, DC 20361-9301	

Topic No. N90-361

Mail/Handcarry Address	SBIR Contact
Commander	Mr. W. Degentesh
Naval Sea Systems Command	(202) 692-9871
Department of the Navy	
Attn: Code CET-4, SBIR Program, Topic No. N90-___	
Washington, DC 20362-5101	

Topic Nos. N90-362 through N90-365

Mail/Handcarry Address
Commander
Naval Surface Warfare Center
Whiteoak Laboratory
Attn: Code S-02, SBIR Program, Topic No. N90-___
Silver Spring, MD 20903-5000

SBIR Contact
Mr. D. Wilson
(202) 394-1279

Topic Nos. N90-366 through N90-373

Mail/Handcarry Address
Commander
Naval Weapons Center
Attn: Code 2503, SBIR Program, Topic No. N90-___
China Lake, CA 93555-6001

SBIR Contact
Ms. L. Herrington
(619) 939-2712

Topic No. N90-374

Mail/Handcarry Address
Commander
Pacific Missile Test Center
Attn: Code 3121, SBIR Program, Topic No. N90-___
Point Mugu, CA 93042-5000

SBIR Contact
Mr. E. W. Patno
(805) 989-7916

Topic No. N90-375

Mail/Handcarry Address
Commander
Naval Training Systems Center
Attn: Code 641, SBIR Program, Topic No. N90-___
Central Florida Research Park
12350 Research Parkway
Orlando, FL 32826

SBIR Contact
Mr. R. Lynchard
(407) 380-4620

Topic No. N90-376 through N90-381

Mail/Handcarry Address
Commanding Officer
Naval Air Propulsion Center
Attn: Code PE31, SBIR Program, Topic No. N90-___
P.O. Box 7176
Trenton, NJ 08628-0176

SBIR Contact
Mr. R. Dobrowolski
(609) 896-5754

Topic No. N90-382 through N90-384

Mail/Handcarry Address
Commander
Naval Ocean Systems Center
Attn: Code 0141, SBIR Program, Topic No. N90-___
San Diego, CA 92152-5000

SBIR Contact
Dr. R. November
(619) 553-2103

Topic No. N90-385 through N90-388

Mail/Handcarry Address
Commander
Naval Air Test Center
Attn: Code CT222, SBIR Program, Topic No. N90-___
Patuxent River, MD 20670

SBIR Contact
Mr. D. Watters
(301) 863-1144

DEPARTMENT OF THE NAVY
FY 1990 TOPIC DESCRIPTIONS

OFFICE OF NAVAL RESEARCH

N90-311 TITLE: Innovative Sensors Based on STM and Related Technology

CATEGORY: Research

OBJECTIVE: To develop a new class of microfabricatable sensors.

DESCRIPTION: The scanning tunneling microscope (STM) has demonstrated exquisite sensitivity of the tunneling phenomena to small changes (0.01nm) in the separation of two surfaces placed on nanometers apart. This sensitivity, and its availability at all fluid/solid interfaces, presents an opportunity to devise new classes of sensors. Preliminary analyses suggest that the tunneling tip may offer distinct signal/noise advantages for microfabricated sensor technologies. Materials which alter their dimension or their position with change in environment, i.e. pressure, temperature, acceleration, gravity, magnetic field, electric field, etc. – can be used with tunneling to detect small changes in the environment. Other influences on the tunneling process due to electric, magnetic or electromagnetic fields may also be exploited for sensing. The goal of this program is to develop new sensor concepts based on microfabricatable tunneling geometries and to investigate their implementation using state-of-the-art technologies.

During the Phase I program research will address (1) new concepts in transducing changes in environment or incidient energy into electronic signals based on tunneling; (2) analysis of the potential signal to noise (S/N) of the transducers; (3) signal processing approaches to enhance the S/N; and (4) system design to realize a sensor package.

During the Phase II program, the Phase I concepts will be further developed to the point of feasibility demonstration for real-time, microfabricatable sensors.

N90-312 TITLE: Group IV Semiconductor Atomic Layer Epitaxial Technology

CATEGORY: Research

OBJECTIVE: To develop self-limiting epitaxial growth.

DESCRIPTION: Chemically self-limiting atomic layer epitaxial (ALE) growth techniques have been known for nearly a decade in the II-VI semiconductors and for several years in the III-V semiconductors. Only recently has the ALE of silicon and compatible insulators been demonstrated. The choices of reactant gases, chamber pressures and temperatures, flow rates, and alternative processes have not yet been optimized, and the full extent to which the growth of semiconductors, insulators, and their interfaces are amenable to ALE is unknown. The technology is expected, inter alia, to significantly impact the production yield of submicron integrated circuit technology.

During the Phase I program, research will address (1) the optimization of reactant gas choices and growth conditions for a selected group IV semiconductor (e.g., silicon, silicon carbide, diamond). Proposals for various alternative chemically self-limiting reaction processes are encouraged.

During the Phase II effort, the Phase I research will be extended (1) to the point of demonstrating feasibility for increased production yields, (2) to demonstrate the efficacy for forming new device structures employing vertical wall ALE for lateral nanometer lithography, and (3) to develop prototype equipment for commercial implementation of self-limiting atomic layer epitaxial growth of group IV semiconductors.

N90-313 TITLE: 4-Dimensional Environmental Sensors

CATEGORY: Research

OBJECTIVE: To develop innovative sensors for environmental parameters.

DESCRIPTION: Innovative sensors and measurement techniques are solicited to obtain marine atmospheric, oceanographic (acoustical, optical, physical, biological, chemical, and geophysical) parameters in 3D space and time. The emphasis is on: (1) novel approaches and concepts to obtain traditional variables, but in 4D; (2) new methods for monitoring previously unmeasured parameters (e.g. fluxes, bubbles, biological distributions, absorption, trace elements, etc.); and/or (3) data transmission concepts (includes data storage and navigation data) to support 4D measurements. Instruments can be towed/tethered sensors, elements in arrays, or suites of instruments on ROVs (remotely operated vehicles) to cite a few examples. Low cost and/or expendable sensors and components are particularly valuable.

In the Phase I proposal, design concepts for measurement of particular or many of the parameters listed above must be described along with the explanation of the new/novel physics, chemistry, etc. involved. Phase I research should provide concept definition with feasibility demonstration of those components that are state-of-the-art or unique untested designs.

Phase II would develop hardware and demonstrate feasibility in the laboratory. Field testing would depend on the opportunity of adding the tests to an ongoing ONR field effort.

N90-314 TITLE: Arctic Environmental Sensors

CATEGORY: Research

OBJECTIVE: To develop new sensors and sensing concepts for Artic environmental forcing parameters and ice motion and deformation.

DESCRIPTION: New remote and in situ sensing concepts and devices are solicited to coherently measure Arctic ice canopy distortion, air/ice and ice/water boundary layer deformation, and ice stress buildup. For example, a small remote aircraft with LIDAR and video camera or an aerostat with a search radar may satisfy imaging of ice and air/ice boundary measurement. An underwater ROV (remotely operated vehicle) with appropriate sensors may solve the ice/ocean boundary quantification needs.

The Arctic ice canopy is a collage of floes that are put into motion by winds, water currents, Coriolis force, and ocean dynamic height acting upon them. Under these influence, the ice drag coefficients and strength of the ice canopy determine its stress level and the motion it undergoes until restricted by continental margins. When the ice floes are gridlocked, stresses build up until the strength of the ice sheet is exceeded, resulting in rafting, ridge/keel building, lead formation, and ice canopy distortion. Imaging the ice distortion over time and space while monitoring air/ice and ice/ocean boundary layer deformation and stress build up in the ice canopy would provide researchers with the input/output parameters needed to develop and verify ice dynamics models.

The Phase I proposals should provide a concept definition of the instrumentation and identify the components that are critical to developing a feasible design. The proposal will lay out a plan that shows how the design and the critical components will be investigated to arrive at a final concept design.

In Phase II, development of an instrument as well as feasibility testing in the laboratory would be required. Field testing would be conducted if an ONR sponsored effort coincides with the project completion.

N90-315 TITLE: Oxidation Resistant Coating for Carbon-Carbon Composites

CATEGORY: Research

OBJECTIVE: To develop new coatings for carbon-carbon composites (CCC) capable of providing oxidation resistance at temperatures in the range 1600-2000 deg. C.

DESCRIPTION: Current protective coating technology for CCC is based on silicon carbide or silicon nitride with boron compounds added to provide a crack filling molten glass. These systems generally protect CCC at temperatures up to 1600 deg. C in air. Advanced gas turbine engine concepts require oxidation resistance in air up to 2000 deg. C and currently there are no coatings capable of providing such protection for CCC. The goal of this program is to explore new concepts of protecting CCC from oxidation in the 1600-2000 deg C temperature range.

During the Phase I program, research will address new protection concepts based either on total prevention of oxygen contact with CCC or ones allowing some contact in conjunction with the removal of the corrosion product (carbon monoxide).

During the Phase II effort, the Phase I concept will be further developed to provide coated CCC engine components and a demonstration of oxidation resistance in tests simulating high temperature service.

N90-316 TITLE: Very High Framing Rate Digital Camera

CATEGORY: Research

OBJECTIVE: To develop a high framing rate camera for use in mechanics measurements systems.

DESCRIPTION: The capabilities of numerous instruments for mechanics measurements are limited by the low framing rate of current video camera systems. Fluid measurement systems, including planar laser induced fluorescence (PLIF), particle image velocimetry (PIV), and planar Rayleigh scattering, are not capable of sufficiently fine time-resolved measurements and their extension to three-dimensional flows is restricted by the framing rate. Similar needs exist in solid mechanics in the areas of underwater explosions, dynamic fracture, high strain rate testing, impact and stress wave analysis.

The currently available cameras that operate at framing rate of the order of 1 million frames/sec can only store a limited number of frames (generally less than 20). High speed video systems have a maximum framing rate of 2000 frames/sec. The envisioned digital camera would use a parallel architecture to write image frames directly into computer memory and have the following characteristics:

512*512 Pixels
8 to 12 bit resolution
100K to 1 million frames/sec
100 – 1000 frames

A camera with these characteristics would have broad applications in engineering and science.

During Phase I, research will address various conceptual parallel architecture schemes, devices and circuits for achieving high framing rates.

During Phase II, one of the concepts will be further developed into a high speed digital camera demonstration in conjunction with one of the above applications.

N90-317 TITLE: Neural Network Applications for Nondestructive Inspection of Aircraft

CATEGORY: Research

OBJECTIVE: To develop new neural network approaches for use in automation of non-destructive inspection of aircraft.

DESCRIPTION: Aircraft reliability and maintenance studies indicate that inspections for aircraft structure/surface flaws resulting from corrosion, fatigue, or stress can be conducted relatively infrequently. However, when

inspections do occur they require painstaking attention to detail, a large number of repetitive measurements and highly skilled pattern recognition capabilities. X-Ray sensors are employed to inspect for cracks, voids, porosity and inclusions, ultra-sonic sensors are used to detect cracks, delaminations, and porosity, and eddy-current detectors are used to evaluate fire damage and to detect surface cracks, pits, porosity and corrosion. Acoustic emission techniques also provide relevant information regarding the aforementioned material flaws. Methods for applying neural network based automatic pattern recognition using input from one or more (i.e., data fusion) of the above sensors are sought. In addition, neural network based systems and concepts for robotic sensor placement will also be considered.

During the Phase I program, research will address the use of neural networks applied to patterns generated by various aircraft inspection techniques.

During the Phase II effort, Phase I concepts will undergo real-world assessment of flaw detection in aircraft mainframes.

N90-318 TITLE: Embedded Transputer-Based System Design

CATEGORY: Research

OBJECTIVE: To develop design approaches and evaluation criteria for a transputer architecture and its interoperability with software based on the theory of concurrency.

DESCRIPTION: Transputer technology provides a means for the development of specialized high speed parallel computer systems. Unfortunately, these complex systems can be constructed without fully understanding their operational behavior. Moreover, transputer technology, programming languages, and simulations do not, by themselves, provide adequate assurances that important liveness and safety properties are satisfied, or that the best design has been developed. Recent developments in theories of concurrency, program transformation, formal analysis methods, algorithm design and mathematical semantics of languages suggest feasible practical approaches to predicting the safety and liveness properties of transputer systems and for the evaluation of classes of design alternatives.

Phase I will produce a conceptual design of a transputer system for a signal analysis application containing demonstrable safety and liveness properties using the component methods described above.

Phase II will produce a research prototype system based on the Phase I design.

OFFICE OF NAVAL TECHNOLOGY

N90-319 TITLE: Non-toxic Antifouling Paint

CATEGORY: Exploratory Development

OBJECTIVE: Develop a maritime antifouling coating system that matches the 80 month overhaul cycle dictated by Navy policy. Further, because of environmental constraints that prohibit the use of organotin paints, the paint should be non-toxic to maritime life.

DESCRIPTION: Fouled hulls present a severe problem for the Navy. Fouling can increase engine power needs by 25% just to maintain the speed attained from a non-fouled hull. An 80 month paint life adds 51.4 ship years of operational availability to current naval capability. Increasingly stringent environmental laws make it impossible to continue using copper based organotin paints. Present copper based paints are not effective against slime, algae or grass.

It is expected that Phase I will identify promising candidate paint systems and develop the rationale for proceeding to a Phase II feasibility demonstration on a small scale.

N90-320 TITLE: Shipborne/Airborne Target Extraction Sensor

CATEGORY: Exploratory Development

OBJECTIVE: Develop of passive IR sensor for detecting low emission targets in a cluttered environment.

DESCRIPTION: The development of low probability of intercept radar and hard to detect targets have made passive shipborne acquisition of incoming threats extremely difficult. To successfully accomplish this task, sensors capable of extracting targets from cluttered backgrounds are needed. A promising technique for aiding in the extraction of these type targets is infrared on-focal plane signal processing. By eliminating pixel-to-pixel spatial content and using time varying content, effective target extracting can occur.

The first phase of this program calls for candidate infrared search and track sensors to be investigated and defined for both a shipborne and airborne applications.

The second phase will demonstrate relevant breadboard hardware.

N90-321 TITLE: Equipment Support Structural Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Develop new beam and truss like supporting structural concepts that will be low in cost, simplified in joining assembly and capable of high strength. These are to be capable of being deployed unassembled in a compact volume for rapid assembly into strong, rigid structures in a variety of configurations.

DESCRIPTION: Navy applications can benefit from the development of field assembled structures to meet a number of emergency situations including ship damage control. In addition, these concepts could also be applied to reducing the costs of fabricating and assembling equipment support structures on ships and submarines. Attributes desired include: (1) Minimum parts and fasteners; (2) Capability of being assembled into a variety of beams and trusses form standard component parts; (3) Capability of being made of metallic, wood, or composite materials; (4) Simple and easy assembly into a variety of configurations; and (5) Capability of field assembly in minimum time. Proposed concept developments should include demonstrating feasibility conceptual designs including strength analysis of the basic elements in a number of configurations.

N90-322 TITLE: Methodology for Decision Making Processes

CATEGORY: Exploratory Development

OBJECTIVE: Develop a methodology which utilizes an “expert system” approach as an aid in the decision making process to help decide if or when Basic Research (6.1) on a particular concept or idea has been or will be conducted to a sufficient degree to warrant transition to Exploratory Development (6.2) and if the research findings and/or developmental objectives can be translated into functional applications.

DESCRIPTION: Conduct a study of advanced technology transition candidates such as magnetohydrodynamic (MHD) (to be provided by the Office of Naval Technology) identifying a technology base decision process and information inputs required to enable a successful 6.1 to 6.2 technology transition. Define the decision process and develop methods of prioritizing obstacles to this transitioning process. Explore expert decision aids, develop an expert system concept and define the information base required to support technology transitions.

Phase I requires the identification and prioritization of the major obstacles, especially “show stoppers” which might prevent further development, as well as the selection and demonstration of a rational approach for the subsequent (Phase 2) development of such a decision aid.

U.S. MARINE CORPS

N90-323 TITLE: Fire Resistant Assault Suit

CATEGORY: Exploratory Development

OBJECTIVE: To develop a lightweight outer garment (jumpsuit) that will provide full body protection to 2000 degress F for a period of no less than two minutes.

DESCRIPTION: Current "Flame Resistant" outer garments have a flash point well below 2000 degrees F and are generally constructed of synthetic fibers which cause secondary and collateral injury at high temperatures. A need exists for a garmet with a high resistance to flame that is lightweight and will not restrict body movement. The suit should be able to be worn during normal military raid missions which may require parachuting, boating, repelling, and swimming.

Phase I would be development of prototypes for evaluation for performance specifications.

Phase II would be refinement of the design and field/user evaluation of a number suits to specified Marine Corps units.

N90-324 TITLE: Noise-Eliminating Assault Radio Headset

CATEGORY: Exploratory Development

OBJECTIVE: To develop a headset that can be effectively used by Marine Corps assault and raid forces.

DESCRIPTION: Current headsets which interface with radios do not offer the user the ability to detect ambient sound as well as information passed over the radio. Likewise, current ear muffs which offer amplitude limiting sensing of ambient noise do nothing to excise broadband ambient noise of varying amplitude. A need exists to develop a novel approach to a radio-interface headset which will allow a user to detect radio information and real-time ambient noise in both ears while excising broadband noise (boat engine, helicopter, generator), while eliminating damaging amplitude noise and while allowing low amplitude noise (voice) to pass to the user. Ideally, the headset will incorporate a capability to pick up user voice signals for transmission over the radio without the use of a boom microphone or external attachment.

Phase I should develop hybrid prototype headsets that can be evaluated for future engineering to better meet required and desired specifications.

Phase II will be the refinement of the design and delivery of test articles and results of laboratories tests designed to measure performance specifications.

N90-325 TITLE: Distributed Explosive Demolition Kit

CATEGORY: Exploratory Development

OBJECTIVE: Investigate and demonstrate the feasibility of developing an improved Explosive Ordnance Disposal (EOD) Demolition Kit utilizing existing and emerging technology in distributed explosives. Additionally, investigate and demonstrate the feasibility of utilizing distributed explosives to accomplish standard military explosives and demolitions tasks.

DESCRIPTION: EOD and standard military demolition tasks cover a broad range of situations and requirements. Present and emerging technology in distributed explosives may be used to increase and broaden present capabilities

in these areas. Such technologies as foam and liquid explosives, ribbon explosives, and miniature shaped/plate charges are presently being developed for application in landmine neutralization.

Phase I: This effort should provide an analysis of EOD and standard military demolition requirements. Distributed explosives candidates should be analyzed for potential application to specific military requirements with theoretical comparisons made between the capabilities of distributed explosives and existing EOD/Standard military demolitions munitions. Recommendations on further development of existing distributed explosives will be made.

Phase II: This effort will include explosive performance modeling of specific distributed explosives as applied to military requirements. Distributed explosives will be procured and sufficient live testing conducted to demonstrate the feasibility of using specific distributed explosives to significantly improve present capabilities in EOD and standard military demolitions. Existing distributed explosives technology will be further developed as required to fulfill requirements. A final report will document analytical and test results and provide recommendations for use of distributed explosives in EOD and standard military demolitions.

N90-326 TITLE: Lightweight Automatic Agent Detector

CATEGORY: Exploratory Development

OBJECTIVE: To develop an inexpensive, reliable, lightweight, automatic agent detector with capability for remote (line-of-site) query and alarm. A version of the detector should be capable of flexible employment as a drop-off sensor to monitor remote areas for contamination.

DESCRIPTION: This SBIR effort will require that contractors have appropriate clearance, secret as a minimum. The detector must be sensitive to a wide range of toxic substances and specifically identify agent class. At a minimum, detectors should be able to directly or indirectly detect presence of G, V, HD, L, AC, CK, and CG type agents at acceptable levels and response time. The detector sensor should use proven miniature technology. Detectors should be considered expendable. Detector must be compact for attachment to clothing and equipment and lightweight. Proper function must be readily verifiable. Detectors must provide audible and visual alarms. Detectors are expected to perform form 125 degrees F to -25 degrees F. The detectors must be capable of unattended operation. Use of MIL-STD batteries is required. Detector sensors must be reusable and capable of quick clear down. Detectors must be capable of 24 hours continuous operation on batteries and have a shelf-life of approximately 5 years. Detector operation must not interfere with communications and electronics equipment used in a Marine rifle company.

Phase I will focus on concept development for a lightweight automatic detector, a drop-off detector configuration, and line-of-site remote warning systems. Specification for detector sensitivities and response performance will be developed as a portion of the SBIR Phase I.

Phase II and III will focus on fabrication, testing and refinement of prototypes.

N90-327 TITLE: This Topic Left Blank

NAVAL AIR SYSTEMS COMMAND

N90-328 TITLE: Electromagnetic Field Sensor for Application to Electromagnetic Compatibility Concerns

CATEGORY: Exploratory Development

OBJECTIVE: Develop wide band electromagnetic sensor system capable of simultaneously and independently measuring the electric and magnetic fields at an air-to-metal boundary such as encountered on equipment outer casings or other primary electromagnetic shields.

DESCRIPTION: The proliferation of electronic technology is producing an increasingly crowded and hostile electromagnetic environment. At the same time, weapon systems platforms are more and more dependent upon survivable operation of computers, communications, navigation, and other electronic subsystems for successful mission performance. It is desirable to have a consistent means for assessing upper level operational electromagnetic environments to establish survivability criteria and for monitoring the environments of operational platforms to give warning when the survivability criteria are being exceeded. A small, lightweight sensor system and application procedures are needed to determine when inherent hardening criteria are exceeded.

Phase I should produce a sensor prototype which uses available sensor technology and establish sensor calibration methods. Procedures for utilization in environmental assessment, equipment testing, and platform monitoring should be established.

Phase II should apply the results of Phase I in developing the necessary sensor systems for application and integration into a specific weapons platform for assessment and testing.

N90-329 TITLE: Non-contact Dimensional Gauging

CATEGORY: Advanced Development

OBJECTIVE: Precision machining and grinding processes are designed to remove metal with an accuracy of 0.0002 inch or less. When cylindrical grinding is being performed the grinder must be stopped several times as the part is dimensionally inspected. Several measurements are necessary as the grinding wheel wears since infeed of 0.001 inch does not remove 0.001 inch of material. A device which reads changes in surface location would enhance productivity as well as optimize accuracies required.

DESCRIPTION: Current in-place measurement of parts being machined or ground is accompanied by measuring the original dimension, removing some metal, measuring the new dimension, removing more metal, measuring the dimension again, and so forth. This method is cumbersome, time-consuming, and the subject part if often machined too much and rejected. The proposed device would enable a remote, non-contact measurement to be taken before machining/grinding is begun. As the part has been measured by contact devices (micrometers, dial indicators, etc.) before machining begins, the original dimension is known, a desired amount of metal will be removed to give the required final dimension, therefore, a change in dimension (delta) is the measurement taken. The metal removal process is then begun and will be able to be located up to three feet from the part and will have a demonstrated measuring accuracy of 0.0002 inch.

Phase I will include an evaluation of currently available non-contact gauging methods (laser, ultrasonic, etc.). The ability of the methods to withstand machine stop environments and meet the demonstrated tolerance are prime considerations.

Phase II includes development of the measuring device such that remote, one-sided measurements of surfaces (32 RMS or better) can be made. A digital readout is required.

N90-330 TITLE: Flight Simulator Visual System Recording/Evaluation Device

CATEGORY: Engineering Development

OBJECTIVE: To record the visual scenes from flight simulators while flown by pilots for later replay and analysis.

DESCRIPTION: Flight simulators have advanced visual systems which are tested and accepted by test pilots or experienced aircrew who fly the simulator. However, while flying the system, all aspects of the visual display may not be observed by the pilots. The pilots will often give overall impression of a problem with the visual display which will not provide enough information to the visual engineer to specify the problem with sufficient detail for correction. A visual recording system that can record the entire field of view that the pilot sees in the simulator

(often 180 degrees by 40 degrees) while he/she is flying the device will provide valuable test and acceptance information.

Phase I should consist of a study outlining the approach which will be undertaken to pursue the requirements addressed above with sufficient data to demonstrate feasibility.

Phase II should use the approach outline in Phase I to develop and deliver to the government for testing a prototype system.

N90-331 TITLE: Miniaturized Solid State Computer Screen Display System with Interactive Voice Control

CATEGORY: Advanced Development

OBJECTIVE: Development of highly miniaturized and portable solid state computer screen display system which may be worn as modified eye-glasses and controlled by voice commands from the operator. Results will lead to the development of alternatives to current computer cathode ray tube or liquid crystal displays with keyboard control in space-restricted environments such as aircraft or submarine.

DESCRIPTION: Currently, almost all computer systems require bulky human interface devices (large screens and keyboards). In certain space-restricted applications such as aircraft and submarines, the benefits of advanced computer technology are foregone because of computer weight and space requirements as well as the lack of mobility for the operator. The development of a computer display system which could be worn as modified eye-glasses and controlled by the operator's voice would significantly reduce or alleviate these requirements and allow the application of computer technology in areas previously untouched by the computer revolution.

Phase I: Identification of existing "off-the-shelf" systems, both in computer solid state display technology and computer interactive voice control systems, as potential candidates for prototype development. Feasibility study and analysis of the effort to integrate the two technologies. Simple prototype development effort at the desktop computer level.

Phase II: Full scale effort to fully integrate and miniaturize the two technologies at a hand-held or belt-carried computer level. Development of demonstration hardware system. Development of demonstration software for two or three fleet applications such as training, maintenance routines, or technical documentation. System testing and evaluation by several designated fleet activities. Identification of system enhancements which would enhance fleet integration.

N90-332 TITLE: Determination of Edge Distance Requirements for Fastener Holes in Advanced Composite Panels

CATEGORY: Engineering Development

OBJECTIVE: To determine the edge distance requirements for installation of fastener holes in newly manufactured and repaired advance composites panels. Phase I is expected to be laboratory research, development, test and evaluation, followed by Phase II which will be a shop floor demonstration where test panels will be manufactured, repaired, tested, and evaluated with the ultimate goal of implementation of these determinations into aircraft composite panel manufacture and repair process.

DESCRIPTION: The manufacture and repair of advance composite structures have serious problems connected with the placement of fastener holes. This is especially relevant to composite panel repair whether repairs have to be made in the field with a minimum of technical support or in a well-equipped and staffed repair facility. More research is required concerning the placement of fastener holes and edge distances in these structures, data has to be developed and the manufacturing and repair processes have to be establish and expanded so that they can be implemented in the aviation maintenance environment. Not so long ago, research and development led to major

gains in fastener technology, fastener placement, and revolutions in edge distance requirements and fatigue life increases in metallic structures. The same effort is needed for composite structures.

N90-333 TITLE: Laser Soldering Inspection System

CATEGORY: Advanced Development

OBJECTIVE: The objectives of this study should be two fold. First, to determine the limitations of both laser soldering and inspection systems. This would entail a comprehensive survey of literature and research facilities that center around the development and implementation of laser soldering and inspection systems. Second, to develop a laser soldering and inspection system that repeatedly provides highly reliable solder connections. This would entail developing a process that is capable of discriminating quality defects within the limitations of automated laser soldering and inspection.

DESCRIPTION: Printed Circuit Assemblies (PCAs) and other electronic components are used extensively in avionic systems requiring a high degree of reliability. PCAs are typically composed of a printed circuit board via solder joints. The solder joints are the fundamental mechanisms that ensure the structural integrity and reliability of the PCA. The purpose of this project is to assess and develop a laser soldering and inspection system that is capable of real-time statistical process control (SPC). The real-time SPC in an automated soldering system will provide timely response for correcting anomalies in manufacturing, thus proving more reliable PCAs.

The development of the laser soldering and inspection system is anticipated to be divided into two phases. Phase I will entail the development of an automated laser inspection process. This will encompass expanding or complementing work that has been accomplished thus far in the electronics industry. This phase will provide an exhaustive report on the causes of repeatability problems within the laser inspection process and recommendations for improvement that have been verified experimentally.

Phase II would involve the integration of the soldering system with the inspection system. A detailed study should be made to determine the critical parameters within the laser soldering system that will have an impact on the quality or reliability of solder connections. From this, algorithms could be developed that would provide real-time SPC capability using output from the laser inspection system.

N90-334 TITLE: Thickness Gauging of Complex Coatings on Turbine Components

CATEGORY: Advanced Development

OBJECTIVE: To develop a thickness gauge using Eddy Current or Beta-Backscatter technology to quickly and accurately determine the amount of coating present on turbine components. This system could be used to monitor coating processes and to evaluate coated blades and vanes while in engines.

DESCRIPTION: Eddy Current and Beta-Backscatter methods have been utilized for sometime to determine coating thickness on various alloys. The choice of method is most often determined by the system being evaluated, i.e. non-conductive coatings on conductive substrates while Eddy Current testers are more successful in testing non-conductive coatings on conductive substrates.

Modern gas turbine engines contain the following material systems:
(a) Thermal barrier coating on Nickel superalloys
(b) Carbide hard-face on Titanium
(c) Corrosion resistant coatings on Nickel superalloys
(d) Plating on stainless steel

Phase I will consist of evaluation of Eddy Current and Beta-Backscatter technologies to determine the optimum method to be employed.

Phase II will consist of purchase/development of the proper equipment for this evaluation. An end-effector probe will be developed in order to allow in situ testing. The "prove" must be capable of reading between surfaces ½ inch apart with convex and concave curvatures as little as 0.050 inch radius. Currently available "proves" require much flatter surfaces.

Thickness range for the coating will be 0.001 inch to 0.030 inch.

N90-335 TITLE: Conformal UHF (SATCOM) Antenna for Tactical Aircraft

CATEGORY: Exploratory Development

OBJECTIVE: Conduct a study to investigate candidate conformal antenna configurations that have high potential for solving UHF SATCOM needs for aircraft. Fabrication of model units will be used to identify and validate pattern coverage and integration requirements for aircraft application.

DESCRIPTION: A need has been identified for extending the Navy aircraft communication nets beyond line-of-sight via satellite communications. This study will identify electrical and mechanical conceptual designs of conformal UHF SATCOM antenna for high performance Navy aircraft. Issues to be addressed will include viability of approach, aerodynamics, mechanical profiles, and an assessment of potential technical risks. Fabrication of "breadboard models" will be used to evaluate and measure radiation patterns, power handling capability (100 watts), weight constrains, feasibility of flush mounted antenna and integration requirements for host platforms such as, F-14, F-18, EA-6A, E-2C and OV-10.

N90-336 TITLE: Aircraft Wheel Usage Indicator System

CATEGORY: Advanced Development

OBJECTIVE: To develop a simple, compact, resetable device attached to an aircraft wheel to measure accumulated usage from wheel installation to wheel removal. If successful, this device would be used to generate and enforce contractor warranties of wheel roll life.

DESCRIPTION: Currently, realistic, enforceable warranties are not used to ensure continued quality wheels are placed on aircraft landing gear. The reasons for this vary, but include: 1) existing systems are either bulky, heavy, or costly; 2) systems are either too simplistic or complicated and, therefore, do not accurately show true usage, or are not suitable for the intended maintenance level; 3) they do not indicate a valid parameter acceptable to both user and supplier. A proper Aircraft Wheel Usage Indicator System would be simple and durable in design to withstand the harsh landing gear environment, small and lightweight to fit within the tight wheel/brake and wheel well envelopes, attached to the wheel and independent of the aircraft for simple flight line replacement, and restable upon wheel disassembly to allow interchangeability between indicators, wheel assemblies, and wheel halves. It would show either accumulated miles, or wheel rotations which are convertible to miles (this might allow for possible placement on different type aircraft).

Phase I should develop an optimal indicator to show the feasibility of accumulating and recording by wheel half the total miles rolled.

Phase II should use the Phase I results and verify the feasibility by providing either prototype units for installation and testing on agreed upon Navy aircraft.

N90-337 TITLE: Aircraft Brake Usage Indicator System

CATEGORY: Advanced Development

OBJECTIVE: To develop a simple, compact, resetable device attached to an aircraft landing gear break to measure accumulated usage from brake installation to brake removal. If successful, this device would be used to generate and enforce contractor warranties of landing gear brake life.

DESCRIPTION: Currently, realistic, enforceable warranties are not used to ensure continued quality brakes are placed on aircraft landing gear. The reasons for this vary, but include: 1) the extreme operating environment (high/low temperatures) make any system of measurement difficult; 2) systems are either too simplistic or complicated and, therefore, do not accurately show true usage, or are not suitable for the intended maintenance level; and 3) they do not indicate a valid parameter acceptable to both user and supplier. A proper Aircraft Brake Usage Indicator System would be simple and durable in design, able to withstand the harsh landing gear environment, small and lightweight to fit within the tight wheel/brake and wheel well envelopes, attached to the brake assembly and independent of the aircraft for simple flight line replacement, and resetable upon brake assemblies. It would show accumulated stops, with the ability to distinguish between low energy stops (taxi), normal energy stops (full stop, normal landing weight aircraft), and high energy stops (full stop, overweight aircraft).

Phase I should develop a propose an optimal indicator system to show the feasibility of accumulating and recording by type the total number of stops. The system should be developed for use on a carbon composite heat sink brake assembly.

Phase II should use the Phase I results and verify the feasibility by providing eight prototype units for installation and testing on an agreed upon Navy aircraft.

N90-338 TITLE: Non-asbestos Replacement Materials for Navy Aircraft

CATEGORY: Engineering Development

OBJECTIVE: Asbestos materials are currently being used in a variety of applications on Naval aircraft. Many of the applications are gaskets used throughout the powerplants system. Due to a recent Environmental Protection Agency (EPA) ruling that will phase-out manufacturing and processing of asbestos in the United States, adequate replacements for asbestos parts on Naval aircraft, especially gaskets, must be identified and qualified, or developed.

DESCRIPTION: Non-asbestos replacement materials such as gaskets used in Navy aircraft powerplants systems must be fully qualified. Adequate replacement materials may be commercially available but these materials must go through a series of evaluations to determine their suitability. If not suitable non-asbestos replacements exist, then these materials must be developed.

Phase I would involve a thorough survey to identify all commercially available replacements.

Phase II would involve material screening tests and performance testing of the top candidate materials. A program of this nature would provide non-asbestos replacement materials and adequate supporting data that will enable NAVAIR to comply with the EPA directive which will band the supply of asbestos sheet gasket materials by August 1993.

N90-339 TITLE: Low-cost Electronic Warfare Response Monitor

CATEGORY: Exploratory Development

OBJECTIVE: To develop a low-cost approach to provide enhanced missile defense training to Navy electronic warfare personnel. This enhanced training can be achieved by the integration of an electronic warfare response monitor into existing flyable missile simulator pods. This response monitor would receive and record electronic responses to threat missile simulators. The data would be used for post mission analysis and increasing training effectiveness.

DESCRIPTION: The AN/AST-6 threat missile simulator pod being procured under a PMA-212 program will provide the fleet with an urgently needed training asset. It can be carried on a variety of Navy aircraft and will replicate a wide-range of threat missiles. Although it is a valuable asset, it will have some limitations. The present AN/AST-6 does not have the capability to monitor electronic countermeasures/tactics used to defeat threat missiles. The capability of the AN/AST-6 can be improved by the development of a low-cost electronic warfare response monitor. The response monitor would consist of a receiver/recorder to provide for post-mission analysis. The response monitor must be small, relatively simple and low in cost.

The Phase I program should investigate low-cost approaches and propose a Phase Ii demonstration program. If this development program is successful, PMA-212 will integrate the electronic warfare response monitor into production AN/AST-6 missile simulators and provide the fleet with enhanced training.

N90-340 TITLE: Advanced Armament Stubwings for Marine Attack Helicopters

CATEGORY: Advanced Development

OBJECTIVE: Develop a state-of-the-art armament stubwing assembly which permits two additional wing stations, providing the capability to utilize anti-armor and air-to-air weapons, and to incorporate other needed improvements, to meet the threat in future Marine attack helicopter combat environments. Explore technology to allow integration of new weapons without requiring the wing stations for each new system. Explore the potential of adding weapons stations on the upper surface of the wing to allow launch of Sidewinder, Sidearm and/or Stinger. This effort should also explore alternate landing gear systems to the present skid system.

DESCRIPTION: The U.S. Marine Corps through new development and a block modification program, will achieve an all AH-1W attack helicopter fleet by the early 1990's. This aircraft must remain capable of meeting the threat well into the 21st century. Because the design of the current armament subwing assembly is based upon antiquated technology, the armament carrying capability of the weapon system is being far outpaced by requirements to carry new and advanced weaponry as the threat dictates. This situation has given rise to the need for development of a new, state-of-the-art subwing assembly that retains all of the capabilities of the current configuration, as well as incorporation of the following: 1. The system would be fully integrated. 2. Advantage would be taken of the recent advances in composite material technology. (The weight of the assembly would be reduced as a result of this application). 3. The system would have two additional weapons stations, while maintaining structural integrity under increased loads during Airborne Combat Maneuvering. 4. The aerodynamics of the system would provide lift or impose zero drag penalty. 5. Materials used should enhance the overall survivability of the aircraft. 6. Explore technology integrating new weapons without rewiring wing stations. 7. Explore the potential of adding additional weapons station on the upper surface of the wing to allow launch of such weapons as Sidewinder, Sidearm and/or Stinger. 8. Investigate alternate landing gear systems to the present skid system.

Phase I of this effort will consist of a design study exploring the incorporation of the improvements discussed above.

Phase II of this effort will develop a conceptual design of a new stubwing, including a mockup.

DATA that can be provided to potential offerors:

1. Schematic drawings of the current stubwing assembly.

DATA that can be provided during Phase I:

1. Government drawings of the present stubwing and aircraft attachment points.
2. Visits to NAVAVNDEPOT, Pensacola, FL the AH-1W rework activity will be arranged to allow first hand examination of the aircraft stubwing attachment points.
3. Other data will be provided on an as needed basis.

N90-341 TITLE: Electro-Optical (E/O Infrared (IR) and Multi-Mode Missile Countermeasures

CATEGORY: Exploratory Development

OBJECTIVE: To develop improved electro-optical and infrared missile countermeasure techniques and concepts.

DESCRIPTION: Currently available Missile Warning Receivers possess an ability to detect and provide warning of hostile aircraft/missiles. Current flares, chaff and on-board countermeasures will continue to face an ever increasing and sophisticated threat in terms of both technical complexity and size. Improved countermeasure techniques and concepts which would enhance own force survivability and would effectively counter this threat is what the Navy desires to improve. A study to explore alternative E/O and IR missile countermeasure (for both on-board and off-board) techniques and/or concepts is desired.

Phase I study and or demonstration must address feasibility and all technical risk factors.

Phase II should demonstrate concept outline in Phase I utilizing prototype hardware/processes.

N90-342 TITLE: Integration of Advanced Technology Components for Airborne Electronic Warfare (EW) Applications

CATEGORY: Exploratory Development

OBJECTIVE: Several on-going technology development efforts eg MIMIC, VHSIC, conformal antenna arrays, GaAs digital radio frequency memories, massive parallel processing, fiber optic interfaces, etc. provide significant performance advantages over current component technologies. To realize the performance gain these component technologies offer they must be integrated into new subsystem architectures which can effectively utilize the speed, power, and size of the various components. Phase I should identify candidate projects and prepare subsystem architecture designs for potential implementation in Phase II.

DESCRIPTION: DoD has investigated a significant amount of funds into the development of these technologies, with some of these technologies proceeding into their second decade of development. The identification of onboard, offboard and integration projects which can utilize these technologies effectively is critical in establishing the production volume needed for economic realization. Phase I should utilize a bottoms-up approach that considers first the utilization of advanced technology to satisfy operational and technical requirements. The integration of these technologies is expected to result in the development of more effective coordinated ECM techniques, affordable channelized receivers with the sensitivity and broadband coverage needed in surveillance and threat warning receivers, and the implementation of stealthy antennas in conformal (smart skins) and shared aperture arrays. MIMIC technology makes possible the economical use of numerous transmit/receive modules necessary in antenna arrays and the use of on-board/off-board pulse and noise ECM techniques. VHSIC and parallel processing techniques provide the speed and processing capability to handle the volume of data and control signals.

Phase I should evaluate the application and availability of advanced technology modules into selected subsystem architectures.

Phase II should provide the specification requirements and detail design for follow-on advanced technology demonstration of a specific subsystem.

N90-343 TITLE: Application of Operations Research Systems Analysis Techniques to Quantitatively Assess Emerging Electronic Warfare Related Technologies

CATEGORY: Advanced Development

OBJECTIVE: Identify and develop operations research systems analysis techniques which provide decision makers quantitative tools for evaluating the potential operational benefits derived from emerging technologies. The successful implementation of this effort would result in the development of investments strategies in technologies that offer the highest technical and operation payoff. The application of these quantitative tools can be used in evaluating and sponsoring contractor IR&D, balanced technology initiative, SBIR's, advanced technology demonstrations, basic research and exploratory development efforts.

DESCRIPTION: The methodology for the quantitative evaluation process should be established during Phase I. Assignment of relative values and weights to numerous factors such as technical merit, operational effectiveness, risks, and cost will provide the input variables in assess competing technologies. The operations research systems analysis techniques to be developed should allow the evaluation of the various technologies in enhance electronics warfare (EW) and EW's contribution to the various Navy missions and Top Level Warfare Requirements (TLWR's).

Phase I results should recommend the operations research technique to be used and describe the utilization of various experts to identify various technologies and to identify real-world programmatic and operational issues including the assignment of relative values and weights to the input variables.

Phase II should develop the algorithms and software programs including the analytical factors and programmatic considerations into a ruled based expert system. The objective is to make these analytical tools available to program managers and sponsors thus the implementation of these software programs should be compatible with available desktop personal computer systems.

N90-344 TITLE: Short Term Stability Attainment Device with Minimal Oscillatory Signature

CATEGORY: Exploratory Development

OBJECTIVE: Development of foundational parameters for the design of an advanced technology personnel parachute for premeditated airdrop and emergency use.

DESCRIPTION: The need exists for research leading to the development of a device that will attain aerodynamic stability with an altitude differential of 250 ft. after having exited from an aircraft with velocity of 150 KIAS and will exhibit an oscillatory signature of less than +/- 10 degrees. Said device must deliver a load of 300 pounds to the earth's surface with an impact of no greater than 52,000 ft lbs/sec/sec. Force loads of less than 6 G's imparted on the load during the stabilization event are desired. Packaging of the device cannot exceed 9500 ccm at atm.

Phase I will develop aerodynamic shapes and mathematical models to provide CD derivation; pre-stabilization load predications; pressure distribution prediction; and computational structural analysis are of particular interest.

Phase II is intended to construct and demonstrate shapes predicted by the math models as having highest potential of achieving the objective.

N90-345 TITLE: Advanced Fire Extinguishant Development

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate the science of chemical extinguishment mechanisms of various known firefighting agents. Propose new methods and materials for enhancement of agent effectiveness and firefighting capability.

DESCRIPTION: The extinguishment of fires can be accomplished both physically and chemically. Water based agents are effective mainly due to the physical cooling effect and the separation of oxygen from the fire. Reactive chemistry is used for more effective extinguishment due to heat generated reaction of the agent with available oxidizers. Such an extinguishment mechanism is said to make Halon agents effective. The currently used Halon fire extinguishants are expected to be eliminated in the future due to their effect on the depletion of the ozone layer, hence the need for further understanding of fire extinguishment phenomena.

An innovative research effort is required for the purpose of identification and characterization of various fire extinguishment mechanisms. An increased understanding of the nature of what is needed to support or suppress fire can lead to improved firefighting or fire suppressing agents and methodologies.

Phase I will address the extinguishment mechanisms and effectiveness.

Phase II efforts will utilize the information found in Phase I for the purpose of designing a next generation firefighting and fire suppressing agent as well as generating a list of candidate agents for the replacement of Halon 1211 and 1301. The contractor should plan one trip to NAVAIR to gather information relative to parallel HALON efforts within the Department of Defense.

N90-346 TITLE: Utility of Enhanced Maneuverability for Tactical Aircraft

CATEGORY: Exploratory Development

OBJECTIVE: To develop a means of evaluating the tactical payoff of Enhanced Fighter Maneuverability (EFM) technologies.

DESCRIPTION: The X-31 aircraft, the flight demonstrator for the EFM program, will have the capability of flying at angles of attack well beyond current operational aircraft. The ability to yaw the aircraft in the post stall flight regime implies, intuitively, a significant advantage in adversary engagements. However, for enhanced maneuverability to become an operational requirement this advantage must be quantified and shown to be useful for specific Naval applications. Thus, a methodology for evaluating enhanced maneuverability as demonstrated by the X-31 for potential tactical benefits is needed.

Issues that must be addressed for effective transfer of EFM technologies concern basic configuration differences between the X-31 and Naval Tactical Aircraft. For example, carrier based aircraft typically do not have the highly swept wings because of low angle of attack landing requirements. A methodology is required to extrapolate the utility of the EFM Interdiction. Additionally, new tactics must be developed which take advantage of enhanced maneuverability, for various engagements as a 1 versus 1 and a many versus many. This information is critical to effective planning of future R&D programs in this area.

Phase I will involve selecting or developing an appropriate approach for measuring the tactical utility of the X-31 and a means of extending that information to other Navy airframes. Select examples will be looked at to demonstrate the methodology. A review of the X-31 flight test program and a plan for using the acquired data will be a deliverable in this phase.

Phase II involves evaluating Naval missions to identify specific improvements in aircraft agility that will be the most beneficial. The methodology of Phase I will also be used to develop tactics which will benefit form the more agile aircraft of the future.

N90-347 TITLE: Enzymatic Deterioration and Removal of Aircraft Coatings

CATEGORY: Exploratory Development

OBJECTIVE: Isolate and characterize the enzymatic process used by microorganisms for the degradation of polyurethane paints. Develop a process for producing such enzymatic activity on a large scale.

DESCRIPTION: Field activities generate large amounts of hazardous waste materials from chemical paint stripping processes. An environmentally safe aircraft paint removal process is greatly needed that will attack polyurethane coatings without generating a hazardous waste.

Micro-organisms have been isolated that are capable of consuming and degrading some polyurethane coating materials. As an environmentally safe paint stripping process, this direct microbial action is slow. However, successful isolation of the bio-molecular activity that attacks polyurethane may result in a more rapid coating degradation and removal process. An innovative development project is needed that makes use of known microbiological activity with polyurethane materials and enhances the activity by isolating the functional biomolecules necessary for such microbial activity.

Phase I efforts will address the biomolecular isolation process from polyurethane degrading micro-organisms.

Coating removal effectiveness and potential for scale-up will be addressed during Phase II.

N90-348 TITLE: Fiber Optic Research for Military Uses

CATEGORY: Basic Research

OBJECTIVE: To investigate and make specific recommendations on maintenance, supportability, testability, and logistic policies for fiber optic hardware components such as fiber cables, single and multi-channel connectors, fiber optic access couplers, cables, data bus structures, transmitters, and receivers.

DESCRIPTION: Fiber optics will be used in new and upcoming aircraft. Existing technology has demonstrated uses for fiber optics in guided weapons, high speed data buses, and "fly-by-light" concepts for aircraft. Currently, testing programs to research maintainability, supportability, testability, and logistics needs of fiber optic hardware components has been slow to develop.

Research in these areas is necessary now, so that current and future policy decisions in these areas can be made with knowledge and confidence.

Phase I should consist of a general research study covering the specific areas of maintainability, supportability, testability, and logistics needs of fiber optic components. At completion of Phase I the government will receive a summary, conclusion, and recommendations for each policy area covered.

With favorable results from Phase I, Phase II should be more in-depth research including lab experiments and field studies to make specific recommendations as to types of fiber optic hardware components to be used in military aircraft and what are the best maintenance, supportability, testability, and logistic policies to be used on these items.

N90-349 TITLE: Prevention of Electromagnetic Pulse Effects on Fiber Optic Connectors

CATEGORY: Basic Research

OBJECTIVE: To investigate ways to make fiber optic connectors less susceptible to the effects of electromagnetic pulses (EMP).

DESCRIPTION: Fiber optics are currently being used for minor operations in today's aircraft and are going to be used more extensively in the future. Most fiber optic strands themselves are not susceptible to EMP, but EMP radiation can enter the fiber through connectors and render it useless. For this reason, research in ways to make fiber optic connectors less susceptible to EMP effects is necessary.

Phase I should consist of a general research study covering ways to specifically improve current and future fiber optic connectors against EMP effects caused by equipment of enemy hostile forces or from nuclear detonation. At completion of Phase I the government will receive a summary, conclusion, and recommendations for making fiber optic connectors more EMP resistant.

With favorable results from Phase I, Phase II would be a more in-depth study of how to prevent EMP effects on fiber optic connectors. Lab experiments and field studies will be included in this phase to help make specific recommendations on how to improve fiber optic connector designs and how to shield current connectors in use against EMP effects.

N90-350 TITLE: Built-In Test Circuitry for Fiber Optic Systems

CATEGORY: Basic Research

OBJECTIVE: To investigate and make specific recommendations on built-in test (BIT) circuitry for applications to fiber optic systems in avionics for primary diagnosis of failing components in the system.

DESCRIPTION: With the use of fiber optics in new and upcoming aircraft increasing, the need for ways to better diagnose fiber optic system component failures has increased. The use of BIT circuitry would improve the level of failure isolation in fiber optic systems and decrease repair and maintenance time. BIT circuitry would also help to reduce peculiar ground support equipment.

Phase I should consist of a general research study analyzing possible BIT circuitry configuration, uses, and equipment. After the completion of Phase I, the government will receive a summary, conclusion, and recommendations for the implementation of BIT circuitry to fiber optic systems.

If there are favorable results from Phase I, Phase II would be a more in-depth research of BIT circuitry including lab and field experiments using fiber optic systems. From this research specific recommendations for types of BIT circuitry equipment, design, and uses for fiber optic systems would be made.

N90-351 TITLE: Artificial Intelligence (AI) and Neural Network Technologies for Mission Planning and Execution Applications

CATEGORY: Exploratory Development

OBJECTIVE: To apply advanced AI and Neural processing techniques to solve mission planning and execution problems which will improve mission effectiveness, reduce aircrew workload and improve operational readiness.

DESCRIPTION: Many manual mission planning and execution tasks could be automated or assisted by the use of artificial intelligence or expert system technologies. With the advances made in processing technology, this automation can be accomplished economically at low to medium risk. The purpose of this effort is to demonstrate the application of AI and Neural processing to mission planning and execution problems and to observe the benefits obtained. Offerors should propose specific technologies to be used along with a specific mission problem to be addressed. The challenge is to derive maximum benefits from these emerging technologies and provide proof of principle with potential transition a resulting new system or provide current system improvement for the users within the next five to fifteen years.

Phase I includes assessment of potential mission planning and execution tasks for automation and identification of promising hardware and software technologies.

Phase II would result in demonstration of the concepts generated in Phase I with consideration for further development and transition to advanced programs.

N90-352 TITLE: Aircraft Integrated Navigation Processing Technology

CATEGORY: Exploratory Development

OBJECTIVE: To explore novel techniques to integrate digital navigation data.

DESCRIPTION: Stand-alone navigation sensors and subsystems are labor intensive, requiring a human navigator's blending and interpretation of data. The time constraints of modern warfare engagements require automated integration of high density digital navigation data from many sources in order to capitalize on the synergism and fault tolerance potential of using multiple navigational aids. The overall objective is to study, design, and develop novel techniques that optimally combine the information from complementary navigation sources using statistical

and time-dependent criteria. Both adaptive digital and analog techniques should be considered. The integrated system is to provide benefits in navigation accuracy, mission reliability and operational efficiency. An initial survey should consider work done to date in integrating inertial, Global Positioning System (GPS), Doppler radar, and air data hardware. Adaptability to different avionics suits and missions is an important consideration, since the outputs are to be used for flight control and mission surveillance/targeting/strike avionics in addition to the basic navigation function.

N90-353 TITLE: Shallow Water Anti-Submarine Warfare (ASW) Sensor

CATEGORY: Exploratory Development

OBJECTIVE: Devise a novel method of detecting submarines in shallow water.

DESCRIPTION: Recent advances in submarine technology, including significant reductions in noise emissions, the use of sound absorbing coatings on submarine hulls, and the use of non-magnetic materials in submarine fabrication, have greatly reduce submarine detectability. These submarine technological advances are reinforced in the shallow water operating environment. Sound reverberations in shallow water serve to quickly obscure returning echoes from sonar and obscure submarine signatures within noisy background. Shallow water turbulence and suspended particulates reduce the usefulness of laser and other optical sensor surveillance methods. Magnetic materials suspended in run-off water and the nearness of mineral deposits to the surface reduce the usefulness of Magnetic Anomaly Detection (MAD) of submarines in shallow water.

The Navy is seeking new submarine acoustic or non-acoustic detection methods for use in shallow water. The methodology should be useful on both nuclear submarines and diesel submarines operating under battery power. The concept must not be currently in use or under investigation by the Navy.

The Phase I study should clearly address feasibility, anticipated cost, and detection levels achievable by the proposed method. The proposal should also include an outline of a proposed Phase II demonstration of the concept.

N90-354 TITLE: Long Range Anti-Submarine Warfare (ASW) Sensor

CATEGORY: Exploratory Development

OBJECTIVE: Devise a novel long range method of detecting deeply submerged submarines.

DESCRIPTION: The traditional methods of long range submarine detection are by active sonar/echo detecting, passive sonic arrays, and by satellite surveillance. The effectiveness of traditional methods of submarines detection has been greatly reduced to recent advances in submarine technology including significant reductions in noise emissions, the use of non-magnetic materials in submarine fabrication, the use of sound absorbing coatings on submarine hulls, and the ability to operate at great depths.

A new concept is sought for the long range (in excess of 100 nautical miles) detection of submarines traveling in the open ocean at great depth (in excess of 500 feet). The concept must not be currently in use or under investigation by the Navy.

The Phase I study should clearly address feasibility, anticipated cost, and detection levels achievable by the proposed method. The proposal should also include an outline of a proposed Phase II demonstration of the concept.

N90-355 TITLE: High Brightness Cockpit Displays Using Field Emit Array (FEA) Or Similar Integrated "Cold" Electron Source Technologies

CATEGORY: Research

OBJECTIVE: Solicit creative approaches to processing and micro-fabrication research related to the development of pixel size integrated "cold" electron sources such as Field Emitter Arrays (FEAs) for eventual use in high brightness cockpit displays.

DESCRIPTION: Cockpit displays are presently dominated by Cathode Ray Tube (CRT) technology which is based on thermionic cathodes. Cathodes have several weaknesses: (1) bulky and require relatively large volumes of cockpit space; (2) require heater power from heavy and bulky power supplies; (3) are susceptible to implosion and other impact destruction; (4) require non-linear deflection magnetic fields and complex alignment circuitry for high spatial resolution color. Liquid Crystal Displays (LCD's), Plasma Displays (PD's), and Electroluminescent Displays (ELD's) have similar weaknesses. The major strength of CRT's is catholoduminescense which has extremely high brightness and dynamic range, full color, high spatial resolution and no penalty in viewing angle. The possibility of microelectronic integrated "cold" electron sources which can be x-y addressed promises flat panel cathodoluminescent displays which have all the advantages LCD's, PD's, and ELD's coupled with the unique strengths of CRT's mention above. The electron source technology could be FEA's or any other suitable integratable "cold" micro-miniature low voltage electron source.

N90-356 TITLE: Application of Dynamic Lift for Enhanced Maneuverability

CATEGORY: Basic Research

OBJECTIVE: Development of a model for analyzing dynamic lift for enhanced maneuverability of tactical aircraft.

DESCRIPTION: The objective of the Navy Advanced Aircraft Systems Program is to demonstrate technologies and capabilities that are critical in attaining performance, maneuverability, and survivability for future Navy aircraft. As part of this program, NAVAIR currently is coordinating and supporting projects to exploit dynamic lift for enhanced fighter maneuverability. It is postulated that dynamic lift can be used for pitch and yaw moments enhancement, especially advantageously in flights at high angle of attack or under high "g." A limitation to the use of dynamic lift is the limited amount of time which this flow condition can be maintained.

While research towards developing stable vortex flow is ongoing, both analytically and experimentally, a basic understanding of the phenomena of vortex-dominated flows is crucial to this objective. The formation of a vortex, the essence of the dynamic lift phenomena, is a highly viscous flow situation where laminar to turbulent flow transition, flow reversal, and separation are occurring very rapidly. To be successful in applying dynamic lift a computational tool is needed.

An innovative approach to modeling dynamic lift which will account for the viscous effects and provide insight for more effective control is required. It is important that the proposed approach have a reliable transition model and be able to analyze regions of separated flow.

Phase I will concentrate on evaluating the state-of-the-art in numerical modeling of unsteady modeling of unsteady aerodynamics and propose an innovative approach for further research. It is important that any proposed effort be well orchestrated with ongoing research in this field.

Phase II will require implementation of this approach for development of a computational tool for dynamic flow control application.

N90-357 TITLE: Assessment on Composite Impact Damage Technology Development

CATEGORY: Exploratory Development

OBJECTIVE: Conduct a comprehensive assessment on the technology development efforts related to Aircraft Battle Damage Repair (ABDR).

DESCRIPTION: Composite materials are used for current navy aircraft and will be extensively used on the next generations of advanced aircraft. The knowledge of mechanisms, assessment methodology and repair techniques of composite damage from impact are being developed. However, to apply this knowledge for ABDR, many technical issues related to logistics, fleet impact are being developed. However, to apply this knowledge for ABDR, many technical issues related to logistics, fleet operation and aircraft performance arise. Technologies required for ABDR are: Nondestructive Evaluations (NDE) methods for damage measurement, testing and modeling techniques for damage evaluations, materials for repairs and characterization techniques (testing and simulation) for performance evaluation of the repair articles.

Phase I effort will be an assessment on ABDR related technologies. The contractor will review 311 technology areas listed above. A report will be provided to identified technologies, programs, and performance organizations.

The Phase II is comprised of two parts. The contractor is expected to collect ABDR requirements unique to fleet logistics and operations through active interaction with navy fleet personal. Based on the requirements and the technologies identified from the Phase I effort, the contractor will develop a road map for the ABDR technology development. The second part of the Phase II effort is to develop and assemble computer simulation codes for NDE measurement technique development, damage assessment and structural performance evaluation of the repair articles. Presently, there are codes which address related technologies but none can be used for ABDR applications without extensive modifications.

N90-358 TITLE: Surface Residual Stress Analysis of Metals and Alloys

CATEGORY: Exploratory Development

OBJECTIVE: Develop a technique and associated equipment capable of quantitative evaluation surface residual stresses in metallic naval airframe materials without the use of ionizing radiation.

DESCRIPTION: Naval aircraft operators must rapidly and quantitatively evaluate the condition of aircraft structural materials in the operational environment of an aircraft carrier. One airframe problem has been the evaluation of surface residual stresses in both ferrous and nonferrous airframe alloys in a way that can be rapidly and safely applied to aircraft in the field and on board carriers. Although x-ray analysis techniques are a proven, effective and quantitative method for residual stress evaluation, they are difficult to apply in restricted areas and are limited by safety considerations. Recently developed procedures using either ultrasound or magnetic hysteresis have been successfully applied to the determination of residual stresses under favorable conditions. Generally, ultrasound techniques have been limited by textural uncertainties, and magnetic techniques have been only applicable to ferromagnetic alloys.

An innovative effort is sought to address these problems in the application of novel approaches to the quantitative analysis of surface residual stresses in both ferrous and non-ferrous alloys. Priority will be given to responses that at least in concept can evaluate stresses in both ferrous and non-ferrous alloys. The potential degree of quantitativeness in the technique will also be an important aspect of selection. Finally, the potential for the development of manually portable equipment to perform the analysis will be evaluated for eventual utilization in the navy aircraft fleet environment. Specific materials on which the technique may be demonstrated are at the discretion of the offeror. Several baseline materials that should be considered, however, are aluminum alloy 7075-T6 and/or 7050-T73, titanium alloy Ti-6AI-4V mill annealed and steel 300M (MIL-S-8844C).

Phase I should evaluate appropriate concepts, and Phase II should develop and demonstrate prototype residual stress equipment at least in the laboratory.

N90-359 TITLE: Thermal Stability Enhancing Additive for JP-5 Fuel

CATEGORY: Advanced Development

OBJECTIVE: Development of an additive that will increase the stability of JP-5 fuel at elevated temperatures without deteriorating the performance of the fuel.

DESCRIPTION: Future generations of gas turbine engines for naval aircraft and missile application have strong requirements for high specific thrust ratios and low specific fuel consumption. In order to meet these goals, gas turbine engines must operate at significantly higher temperatures and pressures. Currently used JP-5 fuel (narrow cut kerosene jet fuel) will oxidize prematurely at the elevated temperatures anticipated in the new turbine engines. Additive technology exists that will extend the elevated temperature stability of jet fuel does not stabilize the fuel at the very high inlet temperatures expected. Also, such technology deteriorates other performance properties of the fuel such as water-shedding ability, low temperature characteristics, filterability and ignition quality.

An innovative additive development effort is required to address the problem of premature oxidation of the fuel due to the high temperatures expected in future generation gas turbine engines. The additive must be compatible with JP-5 fuel in that it does not degrade the important properties of the fuel. In addition, contaminant pickup from shipboard CuNi aviation fuel systems has been shown to degrade the thermal stability of JP-5 and must be addressed in the development.

Phase I efforts should demonstrate the stability enhancing chemistry necessary for high temperature JP-5 performance.

Phase II covers the formulation of doped JP-5 fuel and demonstration of high temperature stability improvement over undoped fuel. Contractor should plan one trip to NAVAIR/NAPC to gather information relevant to fuels and additive technology.

N90-360 TITLE: Cruise Missile Survivability Enhancement Through Deceptive Electronic Countermeasures (ECM)

CATEGORY: Engineering Development

OBJECTIVE: Develop a compact deceptive ECM device for use on cruise missiles to enhance survivability against defensive RF missile systems.

DESCRIPTION: Tomahawk missiles, when employed, will fly within the operating envelope of enemy RF anti-air missiles. Although the RCS of Tomahawk is low, it is likely that RF missiles will be used against Tomahawk. It may be possible that a deceptive RF device carried by Tomahawk can decoy the defensive missile or deny the fire control radar rage thereby causing the defensive missile to miss Tomahawk.

Phase I should consist of analytical first order predictions of performance against direct system and hardware form, fit, and function estimates for compatibility with the Tomahawk missile.

Phase II should include delivery of a prototype device and detailed performance predictions.

NAVAL SEA SYSTEMS COMMAND

N90-361 TITLE: Incentives for Manufacturing Technology

CATEGORY: Exploratory Development

OBJECTIVE: Delineate the knowledge nodes as necessary to incentivise the use of appropriate manufacturing technology into the military sector of the U.S. Industrial Base.

DESCRIPTION: The U.S. Navy has long been vitally interested, if not directly involved in, maintaining a core of domestic shipyard capability. Tacitly with this duty goes there requirement to achieve this goal with a minimum

amount of public expenditures. Similarly, problems can be expected in attaining this objective as a result of predictable reduced demands based on budget costs for military industries.

Present production models associate reduced demands with increased unit cost, which is true if we assume constant manufacturing technology. However, modern flexible manufacturing technology has demonstrated that quantity reduction and unit cost reduction can go together. Hence, it is justified to assume the possibility of an under-proportional output cost versus budget cut, provided sufficient incentives exist to modernize the manufacturing technology in the military sector of the industrial base.

However, manufacturing technology does not exist in a vacuum by itself. It must be seen in its interdisciplinary connectiveness with the economy and legal environment. The intrinsic interwoven aspects of technology, economy and law apply to the wide spectrum from international competitiveness to preparedness and surge. Conceptually, the nature of the problems are the same; only the terminology changes: It is the concern with the well-being of the U.S. Industrial Base.

A pilot study is requested, centered on incentives for manufacturing technology and delineating relevant economic and legal aspects and knowledge nodes to gain the benefits of technological progress to its fullest and to compensate as much as possible for budget cuts.

The study should be generic and determine the boundary of the interdisciplinary system and demonstrate the usefulness to answer eminent practical questions. Some questions may be: Can existing dominant military facilities be used in part for the production of commercial products such as those presently imported? Can commercial and military facilities cooperate in the development of new product lines, either competitive or in the world marketplace or as a substitute for imports? Are cost sharing concepts between military and commercial goods possible, benefiting both? Note all questions have interdisciplinary aspects.

Phase I shall deal with the conceptual problem in order to determine the feasibility of a specific oriented Phase II.

NAVAL SURFACE WARFARE CENTER

N90-362 TITLE: Nonlinear Optical Processing Using Photopolymer Film Technology

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate the application of photopolymer films in optical devices or systems capable of performing real-time nonlinear transformations.

DESCRIPTION: Optical systems provide true parallelism and thus great speed advantages over electronic systems in a large number of signal processing applications. Linear operations such as correlation, convolution and Fourier Transform processing are relatively easy to implement. Many signal processing techniques required to support radar applications require nonlinear optical processing are required in order to perform nonlinear optical properties. This suggests that possible development of optical devices and architectures to perform nonlinear transformations which combine high speed with high resolution and do not require costly and cumbersome spatial light modulators or nonlinear crystals.

N90-363 TITLE: Polarization Insensitive Radomes for High Speed Missiles

CATEGORY: Advanced Development

OBJECTIVE: Successful fabrication and demonstration of a polarization insensitive radome suitable for high speed missile applications.

DESCRIPTION: The need exists for a polarization insensitive radome for high performance ehigh speed homing missiles. The radome must maintain structural integrity during launch and flight. It must be of a shape that is

compatible with low draw high speed missile applications and the electrical performance must be comparable to current half wave radomes. Cancellation of the boresight errors or slopes is acceptable to achieve the required low boresight errors for guidance. However, the in-flight variation of these errors and corresponding cancellation values must be qualified.

N90-364 TITLE: Signal Processing For Anti-Radiation Missile Receivers

CATEGORY: Exploratory Development

OBJECTIVE: Enhance signal processing in missile receivers or surface systems to increase their sensitivity and direction finding accuracy with minimum hardware modification.

DESCRIPTION: Modern anti-radiation missiles are designed to hunt and attack enemy radar installations, but these missiles must become more sophisticated to overcome the increasingly complex countermeasures used against them. They need to be more sensitive in order to detect back and side lobes of targets, and they must also be able to counter advanced waveforms, low-frequency and multiple or expanded frequency usage by targets. One way of improving receiver performance without impacting hardware is to improve signal processing capability. Modern signal processing techniques, such as morphological procedures, higher order statistics (bispection, trispection) and neural network architectures, can be used to increase detection capability as well as the accuracy of direction finding.

Phase I should produce a conceptual design of a receiver which has its signal processing capabilities optimized for naval anti-radiation missiles and/or surface support systems.

Phase II should produce a prototype receiver which should be evaluated in the laboratory and/or in field tests against expected threat radars.

N90-365 TITLE: High Efficiency Ada Compiler

CATEGORY: Exploratory Development

OBJECTIVE: Study the feasibility and implement a high efficiency Ada compiler to minimize system overhead and memory requirements in small, real time systems.

DESCRIPTION: Present Ada compilers impose a very large overhead, a factor of 3 or 4, in terms of operating speed and memory requirements. Small volume and/or power limited real-time systems such as those used in airborne computers cannot function acceptably with such a high overhead, and cannot presently gain the advantages of Ada.

Phase I Definition and Deliverables – A study would investigate the feasibility of a high efficiency Ada computer that would execute with minimal performance degradation and memory requirements, in the range of 16K to 64K bytes for the total system, application and overhead. These requirements are driven by the need to conserve electric power in small systems with self-contained power sources.

Phase II Defintion and Deliverables – A high efficiency Ada compiler would be written and targeted to modern high performance microprocessors such as the Harris RTX2000 Forth engine and/or the Allied Signal 1750A chip. The size of the compiler itself is not critical, but the application program and overhead code must be in the range of 16K to 64K bytes and execute with the absolute minimum of overhead to conserve electrical power. Demonstration of the compiler in an existing airborne computer system, such as the AYK-14, should be included.

NAVAL WEAPONS CENTER

N90-366 TITLE: Amplifying Ferromagnetic Echoing Device

CATEGORY: Exploratory Development

OBJECTIVE: Design (Phase I) and build a bench-test model (Phase II) of an amplifying ferromagnetic echoing device (AFED) to work at 800-900 MHz for certain electronic warfare applications.

DESCRIPTION: An AFED is a circ one-pound device that uses an yttrium-iron-garnet crystal to store a low-power microwave pulse for several microseconds, and then gives out an amplified form of said pulse when triggered by a very narrow recall pulse. AFED's have been built and successfully bench-tested at higher microwave frequencies than stated in this objective, but experience in these efforts has not explored operation down to 800 MHz. The contractor undertaking this task is expected to incorporate the recall pulse generator in his design.

The Phase I output is to be a description and sketches depicting the proposed design and the performance expected.

Phase II is to include a demonstration of performance to Navy personnel and a report including design particulars, photos and test results.

N90-367 TITLE: Light Emitting Diode/Laser Array for Optical Correlator

CATEGORY: Advanced Development

OBJECTIVE: Design, develop, and fabricate a 256 element linear light emitting diode array (or broad band laser diode array) module for use in high speed hybrid optical correlator systems.

DESCRIPTION: High speed optical correlator architectures which use Acousto-optic devices to perform two dimensional convolutions and correlations by processing standard television formatted video signals require a 356 element array of light emitting diodes capable of being modulated by TV video signals. The correlators are required for high speed processing in implementation of special algorithms for target identification and classification. The spacing of the elements are to be 100 microns apart and aligned linearly in a one dimensional array. The individual array elements must be capable of being modulated with NTSC and RS-170 video format signals with a bandwidth up to 10 MHz. Power output coupled into free space for each element must be in excess of 5 milliwatts. The illumination of each element shall be uniform over a 30 degree solid angle. The desired wavelength is to be centered at 830nm and the spectral bandwidth of at least 50nm. The power output variation between elements shall be no greater than 2db. A rugged, compact, power efficient design is desired with appropriate means for cooling the module. Appropriate driver interface circuitry shall be included in the design as well as provisions for protection against over-voltage or over-current burnout.

N90-368 TITLE: Development of Mobile Surface-clutter Mapper

CATEGORY: Exploratory Development

OBJECTIVE: Develop a mobile system that will allow for surface clutter mapping in two or more frequency bands with dual, linear polarization; 60 to 80db of instantaneous dynamic range; and small volume (AZ, EL, Rn) resolution cell. Develop methodology for absolute cross-section calibration. The system will be utilized for development of color-coded display data to be incorporated into test reports. This system will be utilized to probe and characterize the site environment at any given location.

DESCRIPTION: Development Phase I: (1) Establish detailed requirements for the Fully Mobile Surface-Clutter Mapper hardware and software system, and (2) research hardware and software already available which could be (a) modified to perform this task, or (b) used to partially satisfy the requirements for this task.

Development Phase II: Conduct a conceptual study and assess availability of off-the-shelf hardware and software. Next, develop a basic design utilizing existing hardware and software technology.

These two phases would be followed by a Phase III development of a fully functional system to meet the requirements defined in Phase I and the basic design of Phase II.

Beneficiaries: This system could be utilized by all test ranges and Services who have a need to do in-depth accurate clutter mapping.

N90-369 TITLE: Electromagnetic Wave Analysis of Radomes Shielding Spiral Antennas

CATEGORY: Research

OBJECTIVE: To gain a more complete understanding of the Electromagnetic (EM) scattering associated with aerodynamic radomes protecting broadband spiral antennas providing the guidance signals in air-to-ground and air-to-air missiles. Radome induced errors lead to missile guidance errors which may lead to unacceptable miss distances.

DESCRIPTION: All Air-to-Air missiles such as HARM, Sparrow and Side-Arm must have radomes to protect the delicate guidance antennas. These radomes can not be made perfectly transparent to the electromagnetic signals that must pass through the radomes. For HARM, Side-Arm and other new generation missiles, the radome induced errors limit the choice of materials and construction that may be successfully utilized.

To improve the performance of the radomes, or to meet new and more demanding threats, it is desirable to optimize radomes by advanced EM scattering analysis and experimental verification of these computer codes. Also these codes would be Government owned – not company proprietary – for general use in DOD by technically qualified researchers and designers.

Phase I – Computer Code Development

Phase II – Experimental verification of predicted EM scattering characteristics of a generic radome.

NAVAL AIR DEVELOPMENT CENTER

N90-370 TITLE: Parachute Load Transfer Reduction

CATEGORY: Exploratory Development

OBJECTIVE: This effort will result in the design and development of an energy absorbing system that will reduce and regulate the parachute opening shock load transfer to a crew member during emergency ejection.

DESCRIPTION: Ejection from a stricken aircraft is a hazardous undertaking and as the last lie of survival there is always the chance that the crew member will be injured as the sequence of events unfold. The probability of injury by parachute forces increases with the speed and altitude of the aircraft on ejection. At the higher "g's" there is always a time delay period before opening the parachute canopy. Its purpose is to allow the seat to decelerate to a safe velocity before extracting the chute. This is done primarily to keep the canopy structurally intact when it opens and also to reduce the acceleration forces on the crew member to tolerate limits. At the higher altitudes it would be appropriate to let the seat velocity decay to a reasonable speed before opening the chute. However, the selected time delay is a trade-off between the many scenarios under which ejections take place. A long time delay before extracting the chute would be disastrous at low altitudes since precious time will be lost.

Phase I will research available literature to obtain the accelerative forces and loads produced by the opening of a parachute during a ejection sequence. Based upon known physiological limitations to accelerations in the Gz direction and other limiting factors such as angular velocity changes, a working range will be established for the

design of an Energy Absorbing System also call a Load Limiting Device (LLD). Perform preliminary analysis through modeling to establish system design criteria and performance characteristics. Also, conduct feasibility studies for energy attenuation and its location. The contractor will deliver conceptual designs based upon the literature search.

In Phase II the LLD will be designed and fabricated to either interface with the seat bucket structure or as part of the parachute risers. A testing program will be conducted to obtain performance data in Phase II. An ejection seat frame and a parachute will be provided to the contractor for the purpose of testing.

N90-371 TITLE: Dual Function Optical Scanner

CATEGORY: Exploratory Development

OBJECTIVE: To develop passive electro-optical sensor for Air ASW and surveillance

DESCRIPTION: The Navy's infrared imaging equipment provides moderate to high spatial resolution of scenes and targets as low to moderate thermal sensitivity. However, some naval applications such as tactical oceanography and ASW require very high thermal sensitivities. Accordingly, new infrared line scan imaging equipment is needed to provide simultaneously, high spatial resolution of targets and high thermal resolution of the scene. One of the components needed for such a device is a dual function optical system for use in multifunction infrared line scan imaging equipment. Such devices and components are not currently available. This development should proceed in two phases. Phase I is a study with the objective to define and design an optical scanner assembly including the scanner mirror, scanner motor, collecting optics, detector assembly interface and electronics (including sync and position signal generation). This optical scanner assembly shall be capable of collecting infrared radiation simultaneously in both high spatial resolution and high thermal sensitivity modes. Some key characteristics of this optical scanner assembly include (1) F Number – Approximately 2.0, for use with mercury cadmium telluride detectors, (2) Active Scanned Scene Angle -120 degree (60 degree each side of nadir), (3) Reflecting Optics comprising low distortion scanning optics and collecting optics to produce an image on an infrared detector assembly (not part of this SBIR). (4) Rugged construction for airborne military equipment applications.

The Phase I study would conclude with a design for the optical scanner assembly and associated electronics including all required parameters, specification, ray traces and drawings needed to fabricate the device.

Phase II would be the fabrication of the Dual Function Optical System from the design package proposed in Phase I.

N90-372 TITLE: Neural Network Applications to Flight Control

CATEGORY: Exploratory Development

OBJECTIVE: To investigate the possibilities of using neural networks to implement the flight control functions for advanced manned aircraft.

DESCRIPTION: Neural networks have the potential to provide adaptation to changing or uncertain dynamic characteristics of high performance aerospace vehicles, and ever-improving performance through dynamic learning.

The objective of the Phase I effort is to develop and demonstrate (via simulation) a neural network architecture and learning algorithm which will stabilize a representative high performance aircraft exhibiting both static and dynamic instabilities and uncertainties in its plant dynamics. The neural network architecture must also provide acceptable flying qualities in response to pilot inputs through model-reference or other techniques.

Phase II will expand the Phase I results to provide robust control and stabilization features in a disturbed neural network having excellent survivability and fault tolerant properties. Potentials for using neural networks for advanced functions such as automated trajectory control, integrated fire/flight control, and battle damage re-configuration will also be explored in Phase II.

N90-373 TITLE: Miniaturized Metallic Glass Accelerometer

CATEGORY: Exploratory Development

OBJECTIVE: Develop, fabricate, and evaluate a prototype, miniaturized accelerometer, utilizing metallic glass as the transduction material.

DESCRIPTION: The new amorphous magneto-strictive metallic glassy materials exhibit almost perfect magneto-mechanical coupling. This exceptional coupling factor (kz 0.97) can be exploited to achieve a highly sensitive accelerometer, with extended low frequency capabilities in a miniaturized form factor for application in naval underwater systems. Research at two naval laboratories has proven feasibility of a novel bi-directional metallic glass accelerometer; both a theoretical model, capable of predicting performance, and a breadboard sensor, demonstrating the expected performance, have been developed. Further development of this accelerometer is sought, leading to an inexpensive, small, but robust, commercial sensor.

Phase I goals are to review and assimilate the metallic glass sensor development to date, and to successfully design, fabricate, and evaluate a single-channel accelerometer with extended low frequency capability.

Phase II goal will be to develop an optimized bi-directional accelerometer design to meet specific navy performance requirements. This effort is expected to entail an iterative process, consisting of design, fabrication, and evaluation analysis, ultimately leading to a refined prototype accelerometer sensor, capable of being mass-produced.

PACIFIC MISSILE TEST CENTER

N90-374 TITLE: Electronic Optical Vector Scoring System

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop an accurate and reliable vector scoring system for end game analysis.

DESCRIPTION: Test and evaluation ranges need a system for accurately measuring the trajectory of a missile, relative to a target during the final phase of a missile's attack on a target. Current systems are unreliable, difficult to apply, or too expensive. A new approach is needed for solving this problem. State-of-the-art electronic optical detection elements will be developed which will be integrated with solid-state array detector/read electronics, high speed pixel sampling data compression with motion detection and filtering of the pixel output. The electronic optical vector scoring system (EOVSS) shall be designed for use on the target vehicle which is usually an aircraft converted to a drone target or special sub-scale aircraft built specifically for drone target usage.
The EOVSS should be bale to accurately measure and provide a three dimensional output of the position of the missile relative to the target to accuracy's approaching a fraction of an inch. If the missile deploys several smaller missiles/objects during the final approach the EOVSS should provide position output for each of those. The position outputs should be provided regardless of which direction the missile approached the target. Ideally, there should be no modifications to them issile needed to support the EOVSS, however, minor changes such as special coatings should be considered.

Phase I. Develop the detailed block diagram and signal flow diagram for the system. Determine each area/concept involving moderate to high technological risk. Characterize the nature of each risk and what alternative may be available for mediating the problem. Develop the theoretical limits of the system performance.

Phase II should develop prototype hardware and software to be used for test and evaluation.

NAVAL TRAINGING SYSTEMS CENTER

N90-375 TITLE: Texture Modeling Techniques for Simulation of Infrared Sensor Displays for Mission Practice in Night/Low Visibility Conditions

CATEGORY: Exploratory Development

OBJECTIVE: Develop computer image generation (CIG) texture models to assist programmers during development of real-time infrared (IR) displays to be used for mission practice under night/low visibility conditions. Use of texture can increase realism and reduce programming costs associated with development of CIG IR data bases used in simulation weapon system trainers IR avionics and/or other part task avionics simulators.

DESCRIPTION: The use of CIG texture techniques can enhance realism and reduce program development time required to produce data bases for (IR) sensor displays. Current IR simulation methods use physical models to compute the temperature of geometrically simulated 3D objects and terrain in an off-line, non-real-time mode in order to predict the shade/intensity of surfaces appearing in real-time IR displays. The use of texture patterns to fill displayed polygons in the real-time mode can reduce programming complexity while increasing visual complexity of displayed terrain. Reductions in program complexity translate directly into reduced programming and development cost for CIG data base development.

This task should investigate use of texture patterns in simulation of IR imagery for various types of terrain using current computer graphics workstation technology in non-real-time during Phase I and develop a proposal providing extensions to allow real-time simulation for Phase II.

NAVAIL AIR PROPULSION CENTER

N90-376 TITLE: Unmanned Aerial Vehicle (UAV) Propeller Load Control

CATEGORY: Exploratory Development

OBJECTIVE: To provide increased efficiency propulsors for use in block upgrades of the short range UAV and full scale development of the endurance UAV.

DESCRIPTION: The DOD Joint UAV program requires technology which will improve the performance of systems being developed to fulfill the categories of short range and endurance UAV's. This technology should concentrate on improving propulsive efficiencies at applicable flight conditions, thus, resulting in improved system performance. Innovative methods of propeller load control other than conventional mechanical pitch control are desired.

It is desired that the system be lightweight, self-contained and autonomous. Flight test hardware for a 50 HP engine is required in Phase II.

N90-377 TITLE: Unmanned Air Vehicle (AUV Propeller Erosion Protention

CATEGORY: Exploratory Development

OBJECTIVE: To provide low cost propellers for use on UAV's which will improve the capability of close, short range, and endurance UAV systems.

DESCRIPTION: Current operational systems and anticipated future systems use wood or composite propeller blades. These materials have very poor erosion resistance in rain, dust, and other erosive environments. Low cost and durable systems of erosion protection is desired for small wood and composite propellers.

It is desired that in Phase I, two 29 inch wood propellers would be treated with the erosion protection system. These propellers will be evaluated on the pioneer UAV system.

Phase II would develop low cost, high rate production techniques.

N90-378 TITLE: Innovative Small Engine Concepts

CATEGORY: Exploratory Development

OBJECTIVE: To look at breakthrough, state-of-the-art, innovative engine concepts to determine feasibility of concept.

DESCRIPTION: The DOD desired to continue looking for advanced innovative small engine concepts that will advance the present state-of-the-art with applications including remotely piloted vehicles and portable fire pumps. Innovative concepts and design should focus around diesel fuel operation and lightweight construction. It is anticipated that investigation into candidate innovative concepts would be divided into two phases. First, conceptual designs would be generated and validated through theory and analytical assessment and/or testing. Second, based on successful results of the first phase, fabrication of proof of concept designs and experimental verification of the approach would be made.

N90-379 TITLE: Lightweight Remotely Piloted Vehicle Engine Alternator/Starter

CATEGORY: Exploratory Development

OBJECTIVE: To provide a lightweight alternator/starter component weighing much less than 12 lbs. with an output of 3 KW and 28 volts at 4000RPM or less.

DESCRIPTION: The DOD Joint Unmanned Aerial Vehicle Project office desires to field remotely piloted vehicle (RPV) engines for close, short and endurance categories which are highly reliable, provide increased utility and are cost effective. This situation has placed greater emphasis on achieving lightweight engine components capable of handling longer endurance, greater payload capacity and higher reliability. To achieve these more efficient, cost effective systems, it is necessary to exploit various technology areas and extend the state-of-the-art. New and innovative approaches are sought to enhance the alternator/starter subsystem of the RPV engines. The program objective is to design and develop a lightweight alternator/starter component with an output of 3.0 KW and 28.0 volts when operating at 4000 RPM and weighing significantly less than 12 lbs.

It is anticipated that investigation into candidate alternator/starter subsystems would be divided into two phases. First, conceptual designs would be generated and validated through theory and analytical assessment and/or testing. Second, based on successful results of the first phase, fabrication of proof of concept designs and experimental verification of the approach would be made.

N90-380 TITLE: Fuel/Icing Inhibitor Recovery Using Crossflow Membrane Separator

CATEGORY: Exploratory Development

OBJECTIVE: Deter applicability of crossflow membrane separator system to fuel/icing inhibitor additive recovery in ship's JP-5 reclamation system.

DESCRIPTION: Previous testing has shown crossflow membrane separation technology to be efficient at fuel, water and dirt separations. Alternate fiber membrane modules may have capability to recover hydrocarbons (fuel) in tank/filter bottoms and/or recover fuel system icing inhibitor additive for eventual reblending.

Phase I: Determine appropriate fiber membrane for additive separation, demonstrate separation capabilities in laboratory scale prototype.

Phase II: Develop bench-scale prototype fuel/additive reclamation blending system.

N90-381 TITLE: High Energy Density, Long Life Secondary Battery Research and Development

CATEGORY: Advanced Research

OBJECTIVE: To obtain research and development in advancing state-of-the-art secondary battery technology.

DESCRIPTION: The Navy desires high energy density, long operating capacity secondary (rechargeable) battery research and development for use in powering 25-50 HP electric motors. These motors and batteries would be used together with a propeller to power unmanned air vehicles systems. The effort should include an assessment of the current "state-of-the-art" in high density/long life secondary battery characteristics. The program goal is to obtain a secondary battery with an energy density of 600 WH/Kg, or twice that of lithium batteries. Current lithium batteries have an energy density of 300 WH/Kg.

NAVAL OCEAN SYSTEMS CENTER

N90-382 TITLE: Air Traffic Control by 3D Volumetric Display System

CATEGORY: Exploratory Development

OBJECTIVE: The object is to develop multiplanar 3D display system that uses a modulated laser beam which is synchronized with a moving display surface (helix) to address any point in the volume. This display system is to provide true 3D images which would be viewed for air traffic control from any angle.

DESCRIPTION: 3D displays truly offer a port for avionics to communicate a spatial awareness to air traffic controller, or the pilot in all directions. The 3D display approach allows a total spherical world to be generated so that information is conveyed in spatially relevant directions.

Volumetric (multiplanar) displays use X, Y, Z, addressable display volume by physically creating multiple planes. They have the advantage that they require neither binocular or sequential presentation, nor the fusing of virtual images. They simply create a volume which is used as a display surface. The ideal volumetric 3D display system would be viewable from all angles, with naked eyes, simultaneously by several viewers.

Potential applications are characterized by the need to view real 3D objects in a volume. The users could view the objects from various angles to evaluate the real time 3D position of multiple objects. The most obvious near term applications are: cockpit and crew station display, air traffic control, battle management, weather pattern analysis, medical 3D imaging molecular modeling and remote manipulation.

The display system consists of random scan laser beam which is modulated by acousto-optic (AO) modulators and is synchronized with the Z dimension displacement of the rotating helix. The beam is scanned in X and Y, while the synchronization of the modulation with the rotating helix provides the Z dimension. The helix is translucent providing for the optimum persistence of the 3D image which is fused by the observer's eyes.

The display can be theoretically as large as the application requires with as many laser sources as is needed to generate the necessary display elements in real time. The display volumetric can be enlarged by simply increasing the diameter of the helix to meet the application requirements.

N90-383 TITLE: Integrated Planar Magnetics for High Density Power Supplies

CATEGORY: Advanced Development

OBJECTIVE: To explore the technical feasibility of improved performance of magnetic devices for megahertz operation in high power density (100 watts/cm³) power supplies using planar integrated construction. Primary objectives are planar construction, improved power efficiency, higher energy density, and low cost. A baseline for improvements is 2 MHz, frequency, transformer power rating of 100 watts @ greater than 99% efficiency voltage ratio 50-100v (primary) to 5v-3.3v-1.5v (secondary), with a volume not to exceed one tenth cubic inch. Inductor baseline is 300 volt-amperes @ 2 MHz, with a power factor not to exceed 0.0003 and a volume not to exceed one tenth cubic inch using a profile (height divided by length time width) no more than 0.030.

DESCRIPTION: Design/construction of low voltage electronic power supplies must be simplified. The Navy/Air Force are presently contracting for the development of higher efficiency and power density power supplies to provide reliable power to very high speed, high density integrated circuit systems. This is necessary due to the excessive size factor which results with the use of the best available commercial low voltage power supplies. Presently available power supplies would exceed the volume of the remainder of the systems; the rule of thumb is for the power supply's volume not to exceed 25% of the volume of the system.

A major problem in power supply packaging and circuit assembly is the presently design-mandated shapes of the magnetic components, i.e. near cubical in shape. Magnetic devices do not lend themselves to easily conform to high density solid planar structures, rather they are commonly built as separate coil/cord structures which, when assembled, are spacewise inefficient and will not easily conform to the printed circuit layout used for the integrated circuits of the system. This nonconformity dictates greater printed circuit card spacing when the power supply aggravates the system volume by the extended low voltage lines and connector interface serial impedances. Additional decoupling and impedance lowering capacitors must be used for operational reliability. Either card spacing must be increased or added components are required in the conventionally approaches outline above. Therefore, low profile, high performance magnetic components are highly valued. Projected use is in the power management for Avionics, E.W. and JIAWG.

Phase I: Explore the technical feasibility of low profile, highly efficient magnetic devices outlined in the objective. Fabricate and evaluate samples satisfying the above specifications of voltage, power and loss (efficiency) and their characteristics as well as the design principles.

Phase II: Explore low cost production of high reliability components and run a pilot production proving the concept.

N90-384 TITLE: LSI (Large System Integrated) Neural Networks for Associative Memory Arrays

CATEGORY: Advanced Development

OBJECTIVE: Investigate relevant neural network architectures for associative memory arrays, compatible with silicon VLSI circuitry, and demonstrate prototype neural analog memory/computing system.

DESCRIPTION: State-of-the-art digital computing (e.g. RISC architecture) and optical analog signal processing (e.g., Bragg Cells for EW IF channelizers) systems are limited in bandwidth, reliability, material reproducibility and device performance. A resurgence in the field of Artificial Neural Networks (ANNs) which seeks to emulate the biological information processing methods of the brain offers great promise for increasing the information processing capabilities of present technologies. The capabilities are mainly due to the fact that many ANN models are adaptive in nature; that is, they "learn" much like real organisms. Beyond the robotic and telerobotic control, knowledge processing and other AI functions, ANNs offer promise as highly efficient analog computers to the solution of previously intractable problems in sensor interception, as encountered in pattern recognition; image (target) matching; associative computer memory and control; radar and sonar signal processing and preprocessing. ANNs are presently in a phase of hardware implementation to achieve the potential of compactness, speed and parallelism for real time applications.

Phase I (six month duration) will address:

a. Material, devices and architecture of an associative memory array based on ANNs to ultimately achieve 10 to the eleventh and 10 to the twelfth interconnect/sec for application to "matching" (audio, video) problems using multidimensional inputs.

b. Modeling of a storage cell for the ARAM array to be developed; extraction of access time, retention time and dynamic range/error characteristics will be investigated.

Phase II of the effort will explore the practical implementation of the design, followed by a technology demonstration illustrating the several orders of magnitude improvement offered by the physical use of VLSI associative memory arrays based on ANNs. The study of limiting factors affecting the operation of the ARAM array will be carried out; particularly, the following properties will be characterized:

1. Offset errors
2. Noise
3. Linearity
4. Dynamic range
5. Frequency response
6. Power dissipation
7. Susceptibility to parasitic oscillations
8. Modularity

NAVAL AIR TEST CENTER

N90-385 TITLE: Helicopter Simulator Rotor Disk and Blade Element Comparison

CATEGORY: Exploratory Development

OBJECTIVE: Define and analytically demonstrate the differences between helicopter main and tail rotor disk and blade element models in terms of simulator flight fidelity and computation requirements and associated costs. Resultant models will have applicability to helicopter simulators.

DESCRIPTION: Early helicopter Operational Flight Trainers (OFT) and Weapon System Trainers (WST) often used simplified rotor disk models. Increases in computational capability and the desire to improve the helicopter simulator flight fidelity has spurred on development of detailed rotor system blade element models. Tradeoffs exist between increased flight fidelity and associated increased flight simulation program cost.

Phase I requires the investigation of cost tradeoffs between using rotor disks or blade element models in OFT and WST development. It also requires addressing the effect of the rotor model on each element in the simulator flight fidelity test program, analytically defining advantages and disadvantages of each approach. Primary emphasis will be placed on single main rotor, single tail rotor helicopters, with discussions of tandem rotor and tilt rotor type rotorcraft.

Phase II will require development of a generic real-time blade element model with modular structure and standard format for module inputs and outputs; and verification and validation of the model for a specified helicopter, and demonstration tests on a selected Navy simulator. Also determination of the model input data requirements to represent single rotor (articulated and teetering) and tandem helicopters plus tilt-rotor rotorcraft will be required.

N90-386 TITLE: Deep Water Pinger Locator System

CATEGORY: Engineering Development

OBJECTIVE: A system for locating International Distress Pingers mounted on flight data recorders and high value test and evaluation end items such as missiles, drones, and manned tactical aircraft that are in deep water. A market for this system exists among all government and civilian agencies that need to recover flight data recorders and military hardware.

DESCRIPTION: International distress frequency underwater locator beacons (pingers) are installed in flight data recorders and in high value type equipment used in military testing and training worldwide. The current method for locating pingers is manual and is limited by locator system slant range (typically 1 to 2 nautical miles). This limited

range has precluded recovery of the flight data recorders of recent probable terrorist bombings over ocean depths which exceed the locator system range. New technological developments may enable improve ed capability through increased slant range or through an automated search capability. Two approaches must be researched: 1) increase the path budget by increasing either receiver sensitivity or pinger transmit power, or both; 2) placing the locator sensor closer to the pinger by using sonobuoys with extended sensor depth and frequency range or developing and automatic piloted "swimmer" which executes a pre-programmed search path and signals when the pinger is located.

Phase I requires examination of the trade-offs between each approach, including simulations and cost estimates, to develop and deploy hardware and the specification of the system.

Phase II will require production of a fully documented prototype system and demonstration tests at the Naval Air Test Center.

N90-387 TITLE: Dynamic Laser Threat Illumination System

CATEGORY: Engineering Development

OBJECTIVE: A system which can illuminate an aircraft with laser energy equivalent to a threat laser in a hangar environment. This system would have applicability for all types of military aircraft, vehicles, tanks, etc. that require laser warning systems.

DESCRIPTION: Recognizing the increased use of battle field lasers and the dangers involved in flight test of laser warning receivers, testing requiring illuminating the aircraft with dangerous levels of laser energy will be done with an unmanned aircraft in an enclosed hangar. An illumination system is needed which will incorporate, but not be limited to, the following wavelengths: 0.514, 0.532, 1.06 and 10.6 micrometers. The system will have continuously variable output power, pulse width, pulse code, direction of arrival and beam divergence. The laser parameters will be under computer control, with the capability to pre-program, store, and replay a sequence of events. The system must be mobile and modular.

Phase I requires the development and specification of the system.

Phase II will require producing a prototype system for test at the Naval Air Test Center.

N90-388 TITLE: Wide-band Imaging Spectroradiometer System

CATEGORY: Engineering Development

OBJECTIVE: An imaging system to measure the spectral contribution of infrared (IR) targets and projection devices in a variety of discrete spectral bands. A market exists for this system in Government and industry wherever dynamic IR testing is performed.

DESCRIPTION: Current spectroradiometer systems are non-imaging and require changing filters to achieve discrete spectral band measurements. The spectral characteristic of an object can vary over its surface and change over time. An imaging spectroradiometer which could image multiple wavelengths simultaneously or near simultaneously, and measure the IR radiance, would provide superior data for analyzing dynamic events. The system should incorporate computerized image analysis and be transportable with minimum support required for operation.

Phase I requires the design and specification of the system.

Phase II will require the production of a prototype and demonstration tests at the Naval Air Test Center.