AIR FORCE

The responsibility for the implementation and management of the Air Force STTR Program is with the Air Force Materiel Command Deputy Chief of Staff for Science & Technology. The Air Force STTR Program Manager is R. Jill Dickman. Do NOT submit STTR proposals to the AF STTR Program Manager under any circumstances. Inquiries of a general nature or problems that require the attention of the Air Force STTR Program Manager should be directed to her at this address:

Department of The Air Force
HQ/AFMC/STXB (R. Jill Dickman)
4375 Chidlaw Rd
Suite 6
Wright-Patterson AFB OH 45433-5006

Information is key to successful proposal preparation and research. Additional technical information is available by contacting the Air Force point of contact sited after the solicitation topic. Another source for technical information is the Defense Technical Information Center (DTIC), see section 7.1 for more details.

For each Phase I proposal, send one original (with red appendices A and B) and three (3) copies to the office designated below. Also, send an additional set of red appendices A and B, which are not stapled or mutilated in any way. Be advised that any overnight delivery may not reach the appropriate desk within one day.

Topic Number	Activity/Mailing Address (Name and number for mailing proposals and for administrative questions)	Contracting Authority (For contractual questions only)
AF 94T001	Wright Laboratory WL/DOR (Gerry Cassidy) 2130 Eighth Street, Suite 1, Building 45 Wright-Patterson AFB OH 45433-7542 (Gerry Cassidy, 513-255-4119)	Terry Rogers or Bruce Miller (513) 255-5830
AF 94T002 thru AF 94T004	Air Force Office of Scientific Research AFOSR/XPP (Chris Hughes) 110 Duncan Avenue, Suite B115 Bolling AFB DC 20332-0001 (Chris Hughes, 202-767-5015)	Harry Haraldsen (202) 767-4990

AF 94T001 TITLE: Aerospace Technology

DESCRIPTION: Aerospace Technology pursued within Wright Laboratory reflects the mission of six directorates: Avionics, Solid State Electronics, Flight Dynamics, Materials, Armament, and Aero Propulsion and Power:

a) Innovative ideas/concepts are sought for sensors technology. Specific examples include intelligent management of all targeting information; increased target detection range using advanced tracking/processing techniques; long-range all-aspect target recognition/identification; automated target cuing; adaptive processing techniques for operation in presence of clutter and electronic warfare environment; advanced affordable sensor designs for passive and active sensors; weapon and sensor integration (including opto-electronic); combined active and passive systems; wind profiling techniques, spectrometry, and pattern based machine learning.

b) New and innovative approaches to a wide range of electronics and electron device disciplines including nanoelectronic structures, component packaging interconnection, and advanced design techniques are requested. New device concepts and feasibility demonstration efforts are sought for high frequency RF signal amplification; logic and electronic processing; ultra-high speed digital switching devices; advanced semiconductor fabrication technology; high speed/density integrated circuit packaging and high-level integration techniques; and computer based tools for microelectronic design.

c) The need exists for conceptual and mathematical methods and models to quantitatively define the sensitivities, benefits and costs of potential new airframe technologies for aircraft of the next century. The models must represent at least the minimum amount of detail to assess the effects of aircraft configuration, observables, materials, structural concepts, airframe-propulsion integration and manufacturing processes on performance, mission-effectiveness, strength, stiffness and life. They must be consistent with existing multidisciplinary computer software such as Air Force Structures Optimization System (ASTROS) or the Multidisciplinary Analysis and Design Industry Consortium (MADIC).

d) Aerospace materials are increasingly critical to the success of modern weapon systems. The requirements placed upon these materials are stringent, necessitating sophisticated control of structures and properties. New approaches are needed to process these materials for use in military and non-military applications. Examples are closed-loop feedback-based control, including sensors; simulation and modeling; advanced deposition techniques; in-process inspection; and control strategies.

e) New and innovative techniques for high-speed image processing are sought in diverse areas such as ultra-high-speed computation and mass storage, mathematical image processing techniques, image compression, high-resolution displays, and algorithm development. Technologies for image processing should address throughout, size, programmability, and cost. Techniques may encompass a broad spectrum of sensor outputs such as electro-optic, infrared, passive/active millimeter wave, radio frequency, and ultrasound. Both military and commercial payoff in areas such as advanced guidance, surveillance, robotics, medical imaging and telemedicine, and remote sensing are expected.

f) Batteries are used everywhere in Air Force ground and air systems, and throughout the civilian sector. Many of them pose problems in manufacturing (mercury and nickel-cadmium, for example) and disposal. Recycling acids, heavy metals, and reactive materials is very expensive and promises to get worse. New and innovative approaches are sought to meet the often conflicting requirements of energy density, shelf life, weight, reliability, safety and environmental compatibility.

Additional technical information packets for each subtopic may be obtained by calling Gerry Cassidy, 513-255-4119.

AF 94T002 TITLE: Materials Processing - Modeling and Analysis

DESCRIPTION: The focus will be on simulating the transport of fluid flow, heat, and mass during a materials process. Processes to be investigated include chemical and physical vapor disposition for composite processes, and crystal growth for electronic device application - both bulk and thin-film growth of gallium arsenide and indium phosphide. The goal is to incorporate innovative models and computational simulation techniques that account for transport phenomena effects and their influence on final material properties. In the composites area, new processes such as those enabling the use of functionally-graded materials will be addressed. Phase I involves developing transport phenomena models and algorithms that accurately simulate the three main processes described above, and validating the models and algorithms, if possible. Phase II will require the optimization of existing Air Force processing systems and the design and fabrication of new processing systems as guided by the simulation-modeling techniques. (Additional technical information packets for the topic may be obtained by calling Chris Hughes, 202-767-5015.)

AF 94T003 TITLE: Materials for High Temperature Electronic Packaging

DESCRIPTION: Future Air Force applications in airborne radar, electronic warfare, communications systems, nuclear-powered space vehicles, satellite power conditioning, integrated engine electronics and "smart skins" in hypersonic vehicles will impose increasingly higher temperature conditions on their electronic components. The heat may be either inherent within the ambient environment, such as an engine, or generated by the power loads of the integrated circuits. Commercial applications can also be envisioned in aircraft and automotive applications. Current IC devices are limited in their response to approximately 125^{o} C. To operate beyond this temperature necessitates the use of external cooling devices which impose a bulk and weight penalty that increases with increasing operating temperature at the cost of overall reliability. Research is currently underway to extend the temperature response capabilities of GaAs IC devices to $300\text{-}350^{0}$ C with high signal speed, and SiC IC devices to $650\text{-}700^{0}$ C with high power load. The objective of this program is to develop the electronic packaging and interconnect materials technology base to incorporate these IC's into advanced electronic devices, with emphasis on materials requirements for advanced multi-chip, multi-layer design concepts with corresponding operating temperature capability. Materials problems associated with continuous operation at high temperatures and temperature cycling must be addressed, including temperature effects on conductivity/dielectric properties; electrochemical, thermochemical, and thermomechanical stability; thermal conductivity; and interface chemistry and coefficient of thermal mismatch between dissimilar materials. For electronic systems with $300\text{-}350^{0}$ C operational capability, the types of materials considered should include thin layer polymeric dielectrics for optimization of size and weight. For electronic systems with $650\text{-}700^{0}$ C operational capability, thermooxidative constraints limit the dielectric materials to ceramics. Novel concept are sought for each temperature range, such as circuitry using conductive polymers related chemically to polymeric dielectric layers or circuitry using conductive ceramics similar in composition to ceramic dielectric layers. Innovative, potentially low-cost processing technology associated with the materials of choice is also encouraged. (Additional technical information packets for the topic may be obtained by calling Chris Hughes, 202-767-5015.)

AF 94T004 TITLE: Advanced Human-Computer Interfaces

DESCRIPTION: Advanced human-computer interfaces provide faster and more accurate human performance in such diverse contexts as intelligent tutoring, command and control, teleoperation, and scientific visualization. Novel solutions to problems associated with human interface are encouraged to increase the fidelity, bandwidth, and measured utility of systems that use technologies of virtual reality. Improved techniques are desired for conveying visual, auditory, tactile and kinesthetic sensory data to human operators. Novel means of detecting and processing data from human head, eye, limb and hand movements are also needed. Canonical representations of operator state are needed for interfacing with data representating closed loop (e.g. instructional material) or open loop (e.g. natural world environments). Novel techniques are needed to permit access by multiple operators to a single dynamic database. Examples of specific area include, but are not limited to: devices for holographic viewing, techniques for inducing high fidelity tactile perception, techniques for monitoring limb position while providing force feedback, techniques for adapting standard databases for use in virtual environments, techniques for maintaining stability of calibration to afford closed-loop fine motor control, techniques for assessing the value added of novel methods for displaying continuous (e.g. images) or symbolic data. (Additional technical information packets for the topic may be obtained by calling Chris Hughes, 202-767-5015.)

ARMY

Submission of Proposals

The responsibility for the implementation, administration, and management of the U.S. Army STTR Program rests with the Army SBIR/STTR Program Management Office. The Army STTR Program Manager is Mr. Joseph P. Forry. You are invited to send your proposals directly to the following address:

Commander
U.S. Army Materiel Command
ATTN: AMCRD-SBIR (J. Forry)
5001 Eisenhower Avenue
Alexandria, VA 22333
(703) 617-7425

The Army has identified three technical topics, numbered ARMY 94T001 through ARMY 94T003, to which small businesses and their partner research institutes may respond. Please note that these are the only topics for which proposals will be accepted at this time.

The three Army STTR topics presented on the following pages were generated by Army technical organizations in technology areas contained in the Military Critical Technology Listing. Selection of Phase I proposals for funding is based upon technical merit and the evaluation criteria contained in this solicitation document. Due to limited funding, the Army will only fund those proposals which are of superior technical quality and which present excellent opportunities for dual use and commercialization beyond STTR-funded projects.

Please note that the Army will be limiting Phase I awards to $100,000. Any Phase II contracts resulting from these Phase I efforts will be limited to $500,000.

ARMY 94T001 TITLE: <u>High Performance Computing and Simulation</u>

DESCRIPTION: Opportunities for exploiting computer and simulation technologies come from a variety of sources. These include the need for a more efficient military in times of decreasing sizes and budgets; the need to design increasingly sophisticated and complex systems required to support training; the need for complex distributed networks for decision making; the need for the real-time integration of battlefield intelligence to support tactical decisions at all levels; the need to analyze data and identify patterns obtained from diverse sensor sources in the contexts of battlefield intelligence, environmental monitoring, and maintenance diagnostics; the need for more efficient operation of vehicles and other equipment; and the need for the intelligent control of machines required to support advanced manufacturing processes.

A more efficient but smaller military will necessitate improvements in training. Training systems such as the Multiple Integrated Laser Engagement System II (MILES II) and the envisioned follow-on MILES 2000, will provide live simulation, with real equipment and real soldiers but simulated ordnance of indirect fire, area weapons effects, fire and forget weaponry, and directed energy weapons. Sensor devices and computer techniques are needed to record and analyze the status and results of the simulations.

Devices and techniques are also required based on computer-generated virtual reality to support the training of both individual soldiers and field commanders, thus providing the capability of extensive and ongoing training without incurring the higher costs and logistic complexities of live simulations.

Systems of systems (sometimes called supersystems) will become more prevalent in military systems of the future. These super systems are made up of integrated networks of communications and processing systems with contained data bases, and are typically large, distributed, and heterogeneous. Time scales may vary from microseconds to weeks. Because of their complexity and cost, the design of these supersystems requires extensive modeling, simulation, and analysis. New and innovative approaches are needed to address modeling at the physical phenomenon level, the system behavior and performance level, and the operational level in an integrated way.

Computerized techniques are needed to provide tactical commanders with the ability to visualize the battlefield in an easily understandable, three-dimensional perspective that could include information about terrain, environment, and friendly and enemy maneuvers.

Increasing national concern for possible damage to the environment resulting from military activities will require improved techniques for environmental monitoring. Included in these will be computer based techniques for combining data and imagery from multiple sources to perform near-real-time weather analysis, automated terrain reasoning, modeling of terrain background and environmental signatures and the development of comprehensive environmental data.

Fuel-efficient, low pollutant-emission operation of military vehicles will require computerized control based on advanced control algorithms and sensors. Control techniques that appear especially promising are based on artificial intelligence that use instantaneous measurements of in-cylinder engine parameters and novel fuel control systems. Some possible control architectures might be model-based control, rule-based control, fuzzy logic, genetic algorithms, and hybrid (symbolic and numeric) control.

Intelligent manufacturing is becoming critical to both our national defense and our international industrial competitiveness. Sensors, particularly non-contact sensors such as vision systems, are essential ingredients of intelligent manufacturing machines. Often the most effective sensing strategy for a particular process may involve the use of data from many different types of sensors.

Although a number of basic approaches to problems in computer vision and data fusion have been developed, there remain a great many areas in which the present algorithms do not give robust answers. Much additional work on modeling and analysis will be required. Of particular value will be principles, processes, and models that are universal or at least reusable. Examples of required developments can be found in software that can provide an improved geometric environment for editing and manipulating geometric entities in three dimensions. Representative applications would be to geometric models of the kinematics of material transfer, robotics, machine tools, and solid modeling.

ARMY 94T002   TITLE: Sensors and Information Processing

DESCRIPTION: There is a broad need for diverse research and development of sensing devices and techniques in support of a variety of military and private sector applications. The following paragraphs discuss several of our needs.

Improved lidar systems are needed to detect atmospheric turbulence that has cause military and civilian aircraft to crash upon takeoff or landing at airports. Specifically, aircraft mounted lidar systems are needed that can detect downbursts, especially when rain is not present. The lidar systems need to operate near 2 micrometers in order to be eye-safe. Previous studies have suggested that it is possible to build such devices with a capability of sampling wind distribution in a volume approximately 4 km on a side of 1.5 km high at a 30 m resolution every two minutes. The system would be capable of sampling very near the ground as well as aloft (which radar cannot). High precision measurements would improve accuracy of military air drops, as well as contribute to weather forecasting, and improving aircraft safety. Emphasis in development should be on both miniaturization of the sensing and processing system and development of eye safe lidar to measure the spatial structure of the wind velocity fields at scales of tens of meters and times on the order of tens of seconds.

Improved diffractive optical systems are needed which take advantage of recently developed manufacturing techniques developed by the microelectronics industry, using diamond turning, that have allowed the manufacture of general surface relief diffractive optics. A broad range of applications for such optical systems are needed. Diffractive optics can be used to produce anti-reflection structures, needed by the military for low observable (Stealth) application, and by the private sector to reduce infrared reflections where available materials restrict the use of conventional thin film techniques. Hybrid diffractive/refractive optical systems have been used to produce bifocal contact and intraocular lenses. Designs have been made for achromatic hybrid doublets and triplets in the visible, especially for wide field imaging applications. Designs have been made for infrared applications such as Petzval lenses. A novel application utilizes diffractive micro-lenses to improve the efficiency of staring and scanning infrared images. Diffractive optics, used with lasers, can lead to lighter and more efficient CD player optics, and to inexpensive head-ups displays for automotive applications.

Potentially very inexpensive uncooled infrared focal-plane-array (IRFPA) images have recently been demonstrated to be competitive in many applications with the expensive cooled IRFPA images, previously used in military systems. Civilian applications have been limited by cost, but include: driver's aides for augmenting night vision beyond the range of headlights and insensitivity to the blinding effects of oncoming headlights; pilot aides for landing at night or in fog; fire fighting for search and rescue through smoke or dark and for localization of the seat of the flames for fire suppression; perimeter surveillance for security systems, law enforcement; nondestructive material testing, and manufacturing applications such as process control Recent progress indicates that IRFPA imagers have the potential to provide outstanding performance at a cost approaching those of home video cameras. Sensitivities have already been demonstrated which are more than sufficient for most civilian application, and resolution has been demonstrated approaching that of the standard TV format. A broad range of devices and techniques using this new technology is needed.

Development is needed of millimeter-wave electronic devices that are low-power, more easily manufactured than present devices, and affordable for civilian as well as military applications. The rapid development of modern MIC technology has resulted in significant fabrication cost reductions, making practical millimeter-wave systems possible. However, current systems operate at ever-higher frequencies, and operate with low DC-to-RF conversion efficiency, which places severe demands on DC power sources. Improved devices would have a variety of potential applications. For example, the US Army plans to develop a variety of electronic equipment for individual soldier use. Each soldier, tank, etc. would have individual communications, surveillance, and other equipment. Much of this equipment will operate at microwave and millimeter-wave frequencies. Since battery power storage is fundamentally limited, the desired electronic equipment will be possible only by reducing prime power requirement through development of low power/high efficiency millimeter-wave electronics. Civilian applications would include high capacity, light weight personal communications systems.

ARMY 94T003 TITLE: Advance Materials and Manufacturing

DESCRIPTION: Development of advanced materials and innovative, cost effective approaches for processing and incorporating materials in combat systems is essential to meet future battlefield requirements for a more capable "lethal light" and deployable (lighter) "heavy" force. Future land combat forces must be light-weight, highly maneuverable, hard to detect, lethal, and survivable. Integrated systems of active and passive signature control and obscuration, active countermeasures, sensors, communications, and extremely light-weight armor demand advanced materials solutions to meet performance requirements and ensure reliability, durability, and sustainability. Novel synthesis, processing, and characterization techniques, as well as fundamental developments in basic theory, computational/predictive modeling, testing, evaluation and design are needed to develop, assess, and exploit advanced materials and composite/hybrid materials options.

For example, better techniques are needed for processing, characterizing, testing, and specifying thick-section composite materials for vehicle structures. The design and integration of signature control and armor protection into composite structures needs to be addressed, along with durability, survivability, repairability, and affordability. Other materials requirements include: improved lightweight armor materials for personnel equipment and light vehicle protection (toughened ceramic armor plates, thick section composites); advanced tungsten heavy alloys for kinetic energy penetrators; lightweight composite and hybrid materials with high specific strength and environmental durability for structural applications in bridging and weapons platforms; improved mechanical/physical characterization techniques (including ballistic performance, dynamic response, and low impact behavior) for thick section composite materials; NDE techniques for assessing thick section composites and monitoring fiber placement in composite materials; intelligent, automated control and inspection systems for materials processing and fabrication; adhesive bonding of structural composite/hybrid materials; ceramic-ceramic joining; heat resistant ceramic or ceramic matrix composite materials for use as gun-chamber liners and KE penetrator stabilizer fins, tips, and leading edges; low cost, ceramic thermal barrier coatings for gas turbine blades and advanced diesel engine components; high-temperature titanium aluminide and Al-Fe alloys for aircraft and missile engines; environmentally compliant coatings for camouflage, munitions, and chemical agent protection; improved rubber for track, bushings, and roadwheel components; electro-optical/laser (broadband, agile) protective materials for use in individual eye protection, vehicle vision blocks, electro-optic devices and aircraft canopies; thin film polymer/ceramic composite piezoelectric and pyroelectric smart sensors; signature reduction materials and low observable structural materials (radar, visual, and infrared countermeasures) and design schemes for integration in ground vehicles; transparent materials for low observable applications; flexible barrier coatings and laminates for chemical protective clothing and shelters; smart materials which are tunable to survive through measures such as load re-distribution after damage, are responsive to monitor and evaluate the effects of environmental or battle damage, and are active in transforming and proportioning electromagnetic to mechanical energy or vice versa. Additionally needed, is practical development of net-shape forming of ceramic components using gas pressure superplastic deformation and development of recyclable, self-reinforcing polymeric composites produced by extruding liquid crystal polymers blended with thermoplastics.

ADVANCED RESEARCH PROJECTS AGENCY

Submission of Proposals

The Office of Administration and Small Business is responsible for overseeing and implementing ARPA's Small Business Technology Transfer Program (STTR). The ARPA Coordinator who administers the program is Connie Jacobs. ARPA invites small businesses in cooperation with a researcher from a university, contractor-operated federally-funded research and development center, or nonprofit research institution to send proposals directly to ARPA at the following address:

ARPA/OASB/STTR
Attention: Ms. Connie Jacobs
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 696-2448

The topics published in this solicitation are broad in scope. They were developed to bring the small business community and research partners together to meet the technological needs of today. ARPA has identified 7 technical topics, Numbered ARPA 94T-001 through ARPA 94T-007, to which small businesses may respond in the FY94 solicitation. Please note that these are the only topics for which proposals will be accepted at this time.

ARPA's charter is to help maintain U.S. technological superiority over, and to prevent technological surprise by, its potential adversaries. Thus, the ARPA goal is to pursue as many highly imaginative and innovative research ideas and concepts with potential dual-use applicability as the budget and other factors will allow. ARPA's budget for STTR during FY94 is $1M. We expect to make awards of approximately $100,000 each. Phase II proposals will be limited to $250,000, however, additional funding may be available for optional tasks.

ARPA selects proposals for funding based upon technical merit, its potential for commercialization, and other evaluation criteria contained in this solicitation document. ARPA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and highly relevant to the ARPA mission. As a result, ARPA may fund more than one proposal in a specific topic area if the technical quality of the proposals in question is deemed superior, or it may fund no proposals in a topic area. Each proposal submitted to ARPA must have a topic number and can only respond to one topic. However, a small business may submit several proposals to a single topic as long as each proposal is modified with a varied approach.

ARPA does not provide bridge funding between Phase I and Phase II awards. However, we are committed to providing the highest quality of service to small businesses in processing Phase II proposals as they are received at the Agency.

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

ARPA 1994 Phase I STTR
Checklist

1) Proposal Format

a.	Cover Sheet - Appendix A (identify topic number)	______
b.	Project Summary - Appendix B	______
c.	Identification and Significance of Problem or Opportunity	______
d.	Phase I Technical Objectives	______
e.	Phase I Work Plan	______
f.	Related Work	______
g.	Relationship with Future Research and/or Development	______
h.	Potential Post Applications	______
i.	Key Personnel	______
j.	Facilities/Equipment	______
k.	Consultants	______
l.	Prior, Current, or Pending Support	______
m.	Cost Proposal - Appendix C	______
n.	Prior SBIR Awards	______

2) Bindings

a.	Staple proposals in upper left-hand corner.	______
b.	Do not use a cover.	______
c.	Do not use special bindings.	______

3) Page Limitation

a.	Total for each proposal is 25 pages inclusive of cost proposal (Appendix C) and resumes.	______
b.	Beyond the 25 page limit do not send appendices, attachments and/or additional references.	______

4) Submission Requirement for Each Proposal

a.	Original proposal, including signed **RED** Appendices A and B.	______
b.	Four photocopies of original proposal, including signed Appendices A and B.	______
c.	One additional photocopy of Appendices A and B only.	______

ARPA 94T001 TITLE: Low Cost Electronics Manufacturing

DESCRIPTION: ARPA/MTO is soliciting ideas for the low-cost manufacturing of electronic devices and systems. Areas of special interest include semiconductor process synthesis and low-cost thermal imaging systems.

ARPA seeks to develop a semiconductor process synthesis framework, including extended process models, manufacturing tool simulations, and software architectures. By coupling programmable process tools to a process synthesis design environment, reusable designs and production processes can be developed and optimized. The resulting framework will aid integrated circuit designers in the synthesis of new processes and optimization of existing processes for technology and product-specific applications. The goals are the reduction of manufacturing costs and cycle times and an increase in product reliability.

In the area of thermal imaging systems, specialized electronics, made possible through use of process synthesis tools, will be an integral part of a new concept in infrared system technology. Major system modules for lightweight optics, sensor packaging, and cooling technology (if applicable) will be integrated with specialized imaging system electronics for a low cost approach to thermal imaging systems. These modules will be developed with design tools which synthesize the system integration process, taking into account performance, cost, and the interfaces between modules.

REFERENCES:
Lemnios, Zachary J. "Flexible Intelligent Process Equipment," International Symposium on Semiconductor Manufacturing ISSM '93, Austin, TX September 20, 1993. A copy of this paper may be obtained by calling (703)696-2448.

Texas Instruments Technical Journal, September-October 1992.

ARPA 94T002 TITLE: High Energy Electron Beam Processing of Materials

DESCRIPTION: Recent advances of compact high energy electron accelerators open up many exciting opportunities for material processing which were not possible with conventional carbon dioxide lasers and low energy electron beam machines. These accelerators typically produce an electron beam with energy under 10 MeV, and depending on the class of accelerators, the beam current can vary from mA to kA. The electron beam power can vary from tens of kW to one MW. Independent of the current and the power, the unique property offered by these machines is the high energy electron beam capability to penetrate deeply into the materials being processed. Two examples of low power applications are bonding of composites and curing of thick composite structures. In these cases the electron beam initiates polymerization and crosslinking reactions without significant temperature rise in the samples. This results in much lower residual stresses in the materials and shorter curing times. Larger samples can also be accommodated by increasing the beam power and spreading the beam footprint. Examples of high power applications are shock hardening, heat treatment, welding of thick sections of steel, and manufacturing of composite engine parts. Other potential applications of high energy electron beams include toxic waste treatment and food preservation. This solicitation seeks proof-of-principle demonstrations of high energy electron beam processing of materials. An important factor in choosing the demonstration should be the eventual cost-effectiveness and the economic impact. While the major part of the funding will be used for proof-of-principle demonstrations of the various processes, a small percentage of the funding could be used for upgrading the existing accelerators, but the construction of new accelerators will not be supported.

REFERENCE:
"Proceeding on High Energy Electron Beam Welding and Materials Processing," Sep. 21-23, 1993, American Welding Society, 550 NW LeJeune Road, Miami, Florida, 33126.

ARPA 94T003 TITLE: Strategic Planning Tools Based on Object-Oriented Technology

DESCRIPTION: A strategic planning tool is desired to enable program managers for the ARPA information processing science and technology programs to create object-oriented models of program plans, investment strategies, and technology development roadmaps that can be displayed visually, edited graphically, and can serve as input to object-oriented models for risk and maturity analysis. The tools are envisioned to be used by a program manager to provide quantitative and qualitative analysis support for program planning (for example, to help determine technology gaps, assess risk, etc.) and to help other program managers desiring to apply the research results in other programs. For example, it is envisioned that a program manager will build an object-oriented decision analysis model that captures that program manager's rationale for investment decision, program milestones, etc., and allows others to inspect and perform a sensitivity analysis on that rationale. These tools should be fully compatible with current Internet information services and easily interoperable with office automation systems. The tools will be demonstrated on a specific ARPA information processing program such as the Planning and Decision ATD (Advanced Technology Demonstration) Program through consultation with the ARPA program manager selected to manage this project. The tools are intended to exploit evolving ARPA information processing techniques and readily available off-the-shelf commercial hardware and software.

REFERENCES:
Cross, S. "An ARPA Strategic Plan for Intelligent Systems," viewgraphs used in keynote address at the 1993 National Conference on Artificial Intelligence. A copy of these viewgraphs may be obtained by calling (703)696-2448.

Krol, E. The Whole Internet: User's Guide and Catalog. O'Reilly and Associates, Inc., ISBN 1-56592-025-2.

Rouse.W. Strategies for Innovation. John Wiley & Sons, Inc., ISBN 0-471-55904-0.

Rumbaugh, J. Object-Oriented Modeling and Design. Prentice Hall, ISBN 0-13-629841-9.

ARPA 94T004 TITLE: Real Time Contextual Analysis of Multi-Sensor Scenes

DESCRIPTION: Develop real time advanced algorithms for the context-based fusion of multi-sensor scene information. Using a combination of physical models, mobility, expected target and vehicle signatures, knowledge of sensors and environments as constraints, investigate real time implementations which detect, recognize and identify targets, vehicles, and scene features through the use of single and multiple sensor inputs using literal (i.e., camera) and non-literal (i.e., radar) sensors. Special emphasis is placed on the use of non-linear models for clutter and target characterizations; statistical methods not requiring the assumption of an underlying gaussian distribution; representational techniques such as wavelets, image understanding techniques, neural and learning networks; fusion algorithms using Bayesian, Dempster-Shafer and Fuzzy Logic; and physics-based models for signature prediction. Algorithms should be scalable to real time operation on an existing computer architecture. They may be demonstrated in non-real time, provided it is clear that given a realizable configuration, a real time operation is achievable, i.e., scalable to real time given a 1.0-2.5 Giga Operations (GOPS), or massively parallel array, such as Paragon (nominally 200-300 nodes, and less than 128 Megabytes (Mbytes) of memory per node).

REFERENCES:
Image Understanding Workshops, Sep 1990 and April 1993. Dr. Oscar Firschein.

3rd International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems, July 1990.

ARPA 94T005 TITLE: Distributed Micro/Mini Sensor Systems for Tactical Oceanography and Environmental Monitoring in Littoral Areas

DESCRIPTION: A wide range of Air, Strike, Special Operations, and Regional Warfare missions requires continuous, broad-area oceanographic and meteorological data collection and delivery. It is always difficult to collect sufficient environmental data near or inside a potential adversary's territorial zone, but this difficulty is exacerbated during the prelude to hostilities. It is impossible during hostilities. Weather sensing is suspended throughout the area and coastal oceanographic/hydrographic surveys cannot be accomplished. The current Naval Oceanographic Program is unable to supply the continuous, high-accuracy environmental data required to support amphibious operations and the use of precision guided munitions and tactical sensor systems. Advances in micromechanical and electronic systems may allow an entirely different approach to ocean surveillance and environmental monitoring. Oceanographic monitoring might be accomplished with the use of a large number of distributed, expendable micro-sensors. ARPA is interested in both sensor concept and development as well as systems engineering, communication concepts, deployment techniques, etc.

The proposed program will develop the technologies and applications, using overt and clandestine Microelectromechanical Systems (MEMS) sensor devices, to answer this critical need for environmental data collected temporally and spatially throughout the pre-hostility and hostility phases of conflict. Liquid Crystal Shutters (LCS) and photonic filters on silicon chips can range-gate laser radar systems, and are being considered as spatial light modulators to do optical information processing and micro-photospectroscopy. Also, liquid crystal-filled fiber optic sensors modulate a passing laser beam by changes in surrounding conductivity, and can possibly be used as microconductivity probes in conjunction with other inexpensive miniature sensors. MEMS sensors will be developed to accurately measure a range of data, including: bathymetry, currents, tides, sea state, water temperature, visibility through the air and water, air temperature, humidity, refractive index, etc. The technological issues include: development of a MEMS micro-sensor for each data element and combining them, as possible, into single units; position sensing via an ocean surface micro-GPS (Global Positioning System) device; transmission, collection, and collation of data; cost reduction and manufacturing technology for expendable devices; deployment technologies; and power/endurance for the sensors. The emphasis in this program would be to use both micromechanical and microphotometric sensor technology.

REFERENCES:
Brendley, Keith W., and Randall Steeb, "Military Applications of Microelectromechanical Systems," National Defense Research Institute.

Widder, et al (1993), "Large Volume Bioluminescence Bathyphotometer," *Deep-Sea Research* 40 (3):607-627

IEEE/ASME Journal of Microelectromechanical Systems

IEEE Microelectromechanical Workshop Technical Digests

IEEE Transducers '9x Digest of Microelectromechanical Systems

ARPA 94T006 TITLE: Remote Fiber Optic Links

DESCRIPTION: ARPA has maintained a strong effort in the development of fiber optic components and systems for applications to antennas, and is seeking designs which rely on the use of novel components and/or innovative architectures to achieve significant performance gains over current designs. The link designs should significantly advance the state of the art in systems for antenna remoting by providing net link gain, a very low noise figure (better than 4 dB), and extremely high spurious-free dynamic range (in excess of 120 dB/(Hz)-2/3). Fiber optic links should be designed to support typical radar or communication systems applications. Attention should be given to the practical aspects of inserting the technology into a fielded system application including packaging, reliability issues, power consumption, and producibility. These fiber optic links will find numerous applications in military antennas, radar and communications systems, and in antenna ranges and radar cross section measurement chambers. In addition, civilian applications include electromagnetic field sensing, CATV, satellite TV ground stations, and FAA airfield sensing and warning systems.

REFERENCES:
Proceedings of the Third Annual DARPA Symposium on Photonic Systems for Antenna Applications, January 1993, (to be published summer 1993)

Yao and Hendrickson, eds. Proceedings of Optical Technology for Microwave Applications VI, *SPIE Proceedings*, Vol. 1703, April 1992.

Simons, R. Optical Control of Microwave Devices, Artech House, 1990.

ARPA 94T007 TITLE: Graphical Imaging of Waste or Contaminant Flow for Environmental Monitoring System Design

DESCRIPTION: The movement of contaminants, on waterways or underground, has drawn a considerable amount of interest. DoD and DOE have areas where waste has been buried or contaminants have been dumped on the ground. In some cases, these contaminants have reached ground water, moved between layers in the soil, or have made their way into streams and rivers. These source areas now require cleanup.

Before cleanup can begin, the area or site has to be characterized. The present means of characterizing a site requires drilling of wells and sampling for contaminants. Waterways are also sampled. The samples are then taken to laboratories for analysis. This process is quite costly.

In order to better estimate the location of wastes and contaminants and minimize drilling and sampling time, graphical imaging tools are needed. These tools would allow a site characterization team to better locate the contaminated areas, thus focusing their activities. Additionally, the remediation teams would use this same tool to help focus their efforts.

Based on various geological and waterway data, the imaging tools should be able to depict both the contaminant source and movement. Movement of the contaminant through soil strata, underground aquifers, and waterways should be modeled and depicted on a personal computer or graphics workstation. Various contaminants should be depicted based on a user-selected color code. The graphical imaging tools should show the movement of contaminants over time.

Aside from DoD and DOE site cleanup, this same tool could have utility in locating signatures of nuclear, chemical, and biological weapons proliferation. Production of these weapons of mass destruction results in signatures which can be found in the atmosphere, waterways, or soil. If the proliferator attempts to hide production, contaminants (or signatures) may be released into the soil or waterways which surround the production area. As one example, news reports have indicated the existence of weapons production facilities underground. Proliferators operating underground facilities could attempt to hide production by dumping wastes into underground aquifers, into waterways, or on the soil.

BALLISTIC MISSILE DEFENSE ORGANIZATION (BMDO)
SMALL BUSINESS TECHNOLOGY TRANSFER PROGRAM
Submitting Proposals

Send **five** copies of Phase I proposals to:

Ballistic Missile Defense Organization
7100 Defense Pentagon
ATTN: DTI/STTR
Washington, DC 20301-7100

(Appendix A and B need not be red)
For administrative help **ONLY**: call **800-937-3150**

Proposals delivered by means other than US Mail must be delivered to Room 1D110, The Pentagon, Washington, DC. **WARNING: Only persons with access to the interior of the Pentagon building can reach Room 1D110. Delivery to a Pentagon entrance is not sufficient.** BMDO will acknowledge receipt if the proposal includes a self-addressed stamped envelope.

BMDO seeks the most innovative technology to find and disable a missile in flight -lighter, faster, smarter, more reliable components. Proposers need not know details of possible BMDO systems.

BMDO seeks to invest seed-capital, to supplement private capital, in a product with a future market potential (preferably private sector) and a measurable BMDO benefit. BMDO will not compete with private or government markets in that it will not further develop concepts already mature enough to compete for private capital or government development funds. BMDO prefers projects which move technology from the non-profit institution into the private sector market through a market-oriented small firm. BMDO expects to fund about 20 projects.

Phase I should be only an examination of the feasibility and competitive merit of the concept with an average cost about $60,000. Although proposed cost will not affect selection for negotiation, contracting may be delayed if BMDO reduces the cost ceiling. Phase I competition will give approximately equal weight to degree of innovation and market potential. Phase II competition will give more weight to future market potential. BMDO expects keen competition for both Phases.

Principal Investigators in the small firm may not be tenured faculty receiving compensation from a university.

Because BMDO seeks the best nation-wide experts in innovative technology, proposers may suggest both technical reviewers and contract technical monitors by enclosing a cover letter with the name, organization, address and phone number (if known), and a rationale for each suggestion. Each must be a government employee. BMDO promises only to consider the suggestion.

BMDO 94T001 TITLE: Sensors

DESCRIPTION: Sensors provide warning of attack, target identification, target discrimination from non-target objects, and determination of kill. New and innovative approaches are sought for sensors in the infrared, visible, and ultraviolet wavelengths for passive, active, and interactive sensors. Examples are: cryogenic cooling, superconducting focal plane elements, low power optical beam steering, passive focal plane imaging, interferometry for imaging, optics, diode pumped lasers, and optical materials.

BMDO 94T002 TITLE: Electronics and Photonics

DESCRIPTION: BMDO needs advances in processing capacity made possible by advances in electronics and opto-electronics. BMDO wants to advance integrated circuits, detectors, sensors, large scale integration, and radiation hardness. Advances are sought in band gap engineering, single crystal diamond, solid state lasers, optical detectors, electronics packaging, and any other related breakthrough technology.

BMDO 94T003 TITLE: Computing

DESCRIPTION: BMDO seeks advances in processing massive amounts of battle information for discriminating targets, controlling a defense, operating interceptors, and measuring results. Advances sought include computer architecture, very high level language, algorithms, neural networks, fault tolerance and other advances.

BMDO 94T004 TITLE: Surprises and Opportunities

DESCRIPTION: BMDO recognizes that, at the leading edge of technology, surprises and opportunities may arise from creative minds and entrepreneurs. BMDO will consider proposals in other technologies that present an extraordinary opportunity for BMDO. But proposals will receive a preliminary screening that may reject them without full technical review as not offering enough of an extraordinary opportunity. This open call is for breakthrough technology with great market potential beyond the standards for the topics listed above.

NAVY

Proposal Submission

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

Office of Naval Research
ATTN: Mr. Vincent D. Schaper
ONR 412 E
800 North Quincy Street
Arlington, VA 22217-5660
(703) 696-4286

<u>All STTR proposals submitted in response to a Navy STTR topic should be sent to the above address</u>.

This solicitation contains three technical topics that meet the mission requirements of the Navy and PL 102-564 to which small R&D businesses together with a research institution may respond. As in SBIR solicitations the Navy will provide potential awardees the opportunity to reduce the gap between phases I & II by providing a $70,000 Phase I proposal award and a $30,000 Phase I Option award or may elect to just submit a Phase I proposal for $100,000. If an awardee chose the former, the Option effort should form the initial part of the Phase II work. If a potential awardee chooses the later, recognize that: 1) they forfeit the ability to reduce the gap and 2) risk the possibility of loosing an award if there exists a tie with a lower priced proposal (see sections 4.2 and 4.3, Evaluation Criteria). Only an awardee whose Phase II proposal has been recommended and selected for award will be funded for the Phase I Option. Therefore, those who have finished or almost finished their Phase I and asked to submit their Phase II proposal should do so. The Phase II proposal should contain three elements: 1) a plan of how the proposer will commercialize the technology to the government and the private sector; 2) a Phase II work plan; and 3) a Phase II option. At the end of the Phase II portion, a determination will be made by the Navy as to whether the proposer has satisfied the commercialization plan sufficiently for the government to fund the "Phase II option" portion of the proposal. The Phase II option should address the further R&D or test and evaluation aspects of the proposal. The total Phase II funding should not exceed $500,000 with 80% going to the Phase II and 20% for the "option Phase II".

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

NAVY 94T001 TITLE: Electronic Components & Systems\Electronics

DESCRIPTION: Solid state electronic materials, devices, components, and systems are widely used in many Navy/DoD as well as civilian computer and signal processing systems. New and innovative approaches to developing, designing, and fabricating high performance electronic devices and systems are sought and encouraged. Proposals may be submitted to either the general or specific portion of this topic.

A. General. Innovative approaches in any of the following areas are encouraged.

Materials - Innovative fabrication techniques for making thin atomic layers of solid state materials, and techniques for in-situ monitoring of the growth process are encouraged.

Components - Nanoscale electronic devices are sought, including quantum tunneling devices, quantum wells and multiple quantum wells, mesoscale devices, and single electron transistors.

Sensors - Sensors of various types to detect signals in the acoustic and the entire electromagnetic spectrum ranging from EM, visible light, IR, and UV, are sought, as well as microminiature sensors to detect accelerations, mechanical vibrations, and fractures in materials.

Signal processors - Signal processing architectures to exploit the very large scale integration (VLSI) device technology to achieve real-time signal and image processing are sought.

Computers - Multiprocessor and parallel computer architectures and realizations that are affordable to achieve GOPS in computation throughputs are encouraged.

B. Specific. The Navy recognizes a need for research in the following specific areas.

Materials - Innovative techniques employing MBE, MOCVD, ALE, or Supersonic jets to optimize epitaxial growth of semiconductor materials, including wide bandgap materials.

Devices - Innovative devices using III-V, II-IV, and Group IV semiconductors such as GaAs, AlGaAs, InP, SiGe, SiC, and Diamonds.

Sensors - Multispectral IR sensors such as InTlSb and MQW together with on-chip signal processing.

Signal processors - Massively parallel signal processors such as systolic arrays and cellular neural networks for real-time image and signal processing.

NAVY 94T002 TITLE: High Power Semiconductors\Electronics

DESCRIPTION: Significant improvements in cost, weight, and volume can be realized in aircraft, submarines, and other vehicles by replacing hydraulic systems with electronic actuators and drives, but these devices require semiconductor devices capable of handling voltage, current, and thermal loads considerably in excess of conventional silicon, germanium, and gallium arsenide devices. Examples of new semiconductor materials sought include: silicon carbide (2H, 4H, & 3C), gallium nitride, aluminum nitride, boron nitride, and alloys of all of these materials. High Power diodes, Field Effect Transistors (FETs), bipolar transistors, and Heterojunction Bipolar Transistors (HBTs) of these semiconductor materials are expected to be designed and tested in phase II programs.

NAVY 94T003 TITLE: Signal Processing Chips/Electronics

Description: The processing of complex signals (speech, sonar, vision) is typically addressed via algorithms that are inherently based on serial processing technologies, unsuited to efficient implementation, portability, or real-time performance. However, most contemplated military or industrial applications call for portable, real-time operation (e.g., on-site sonar, speech processing, and image recognition). Recent novel signal processing algorithms have been shown to have characteristics that confer very good scaling properties [o(n logn)] that lend themselves to very efficient large-scale silicon implementation. Some of the characteristics are derived from biological systems and include: Sparse connectivity, simple learning rules, low-precision operating steps, asynchronous processing, continuous feedback between early and late processes, and the ability to fuse data from one or more sensors. Some of these new algorithms may be derived from specific biological systems (e.g., auditory and visual cortex) or emulate biological processes (e.g., sensor fusion, inhibition, expectation). Low power dissipation and high processing speeds are, of course, an advantage. Design and demonstrate a fully functional prototype signal processing chip.