The Department of Defense

DEPARTMENT/AGENCIES PARTICIPATING:

Department of the Army

Department of the Navy

DARPA

Defense Advanced Research Projects Agency

PROGRAM SOLICITATION 91.2
CLOSING DATE: 1 JULY 1991

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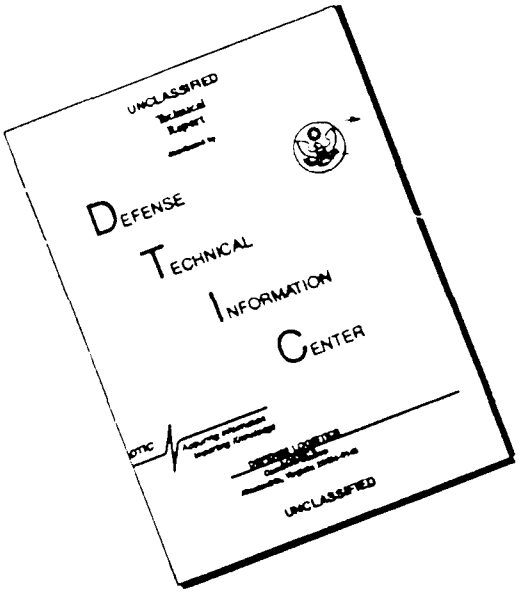

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PROGRAM SOLICITATION

Number 91.2

Small Business Innovation Research Program

U.S. Department of Defense

SBIR Program Office

Washington, DC 20301

Closing Date: JULY 1, 1991

TABLE OF CONTENTS

REFERENCES

DoD PROGRAM SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH

1.0 PROGRAM DESCRIPTION

1.1 Introduction

The Army, Navy, and the Defense Advanced Research Projects Agency (DARPA), hereafter referred to as DoD Components, invite small business firms to submit proposals under this program solicitation entitled Small Business Innovation Research (SBIR). Firms with strong research and development capabilities in science or engineering in any of the topic areas described in Appendix D are encouraged to participate. Subject to availability of funds, DoD Components will support high quality research or research and development proposals of innovative concepts to solve the listed defense related scientific or engineering problems.

Objectives of the DoD SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DOD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD supported research or research and development results.

The Federal SBIR Program is mandated by Public Laws PL 97-219 and PL 99-443. The basic design of the DoD SBIR Program is in accordance with the Small Business Administration (SBA) SBIR Policy Directive, June 1988. The DoD Program presented in this solicitation strives to encourage scientific and technical innovation in areas specifically identified by DoD Components. The guidelines presented in this solicitation incorporate and exploit the flexibility of the SBA Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DoD. Results from prior years are shown in Reference A at the back of this solicitation.

1.2 Three Phase Program

This program solicitation is issued pursuant to the Small Business Innovation Development Act of 1982, PL 97-219 and PL 99-443. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas submitted under the SBIR Program and will typically be one half-person year effort over a period not to exceed six months. Proposals should concentrate on that research or research and development which will significantly contribute to proving the scientific and technical feasibility of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. The measure of Phase I success includes evaluations of the extent to which Phase II results have the potential to yield a product or process of continuing importance to DoD. Proposers are asked to consider whether the research and development they are proposing to DoD Components also has commercial possibilities, either for the proposed application or as a base for other applications. If it appears to have such potential, proposers are encouraged, on an optional basis, to obtain a contingent commitment for private follow-on funding to pursue further development of the commercial potential after the government funded research and development phases.

Subsequent Phase II awards will be made to firms only on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months, subject to negotiation. Phase II is the principal research or research and development effort and is expected to produce a well defined deliverable product or process. A more comprehensive proposal will be required for Phase II.

Under Phase III, non-federal capital is expected to be used by the small business to pursue commercial applications of the research or development. Also, under Phase III, federal agencies may award non-SBIR funded follow-on contracts for products or processes which meet the mission needs of those agencies. This solicitation is designed in part, to provide incentives for the conversion of federally sponsored research and development innovation in the private sector. The federal research and development can serve as both a technical and pre-venture capital base for ideas which may have commercial potential.

This solicitation is for Phase I proposals only. Any proposal submitted under prior SBIR solicitations will not be considered under this solicitation; however, offerors who were not awarded a contract in response to a particular topic under prior SBIR solicitations are free to update or modify and submit the same or modified proposal if it is responsive to any of the topics listed in Appendix D hereto.

For Phase II, no separate solicitation will be issued as only those firms that were awarded Phase I contracts will be considered (Section 4.3 and 5.2).

DoD is not obligated to make any awards under either Phase I, II or III. DoD is not responsible for any monies expended by the proposer before award of any contract.

1.3 Follow-On Funding

In addition to supporting scientific and engineering research development, another important goal of the program is conversion of DoD supported research or research and development into technological innovation by private firms. Therefore, on an optional basis, the DoD Program includes an incentive for proposers to obtain a contingent commitment for private follow-on funding prior to Phase II to continue the innovation process where it is felt that the research or research and development also have commercial potential.

Proposers who feel that their research or research and development have the potential to meet market needs, in addition to meeting DoD objectives, are encouraged to obtain non-federal follow-on funding for Phase III to pursue commercial development. The commitment should be obtained during the course of Phase I performance. This commitment may be contingent on the DoD supported research or development meeting some specific technical objectives in Phase II which if met, would justify non-federal funding to pursue further development for commercial purposes in Phase III. *Note that when several Phase II proposals are evaluated as being of approximately equal merit, proposals that demonstrate such a commitment for follow-on funding will receive extra consideration during the evaluation process.*

The recipient will be permitted to obtain commercial rights to any invention made in either Phase I or Phase II, subject to the patent policies as stated in this solicitation Section 5.7.

1.4 Eligibility and Limitation

Each proposer must qualify as a small business for research or research and development purposes as defined in Section 2.0 and certify to this on the Cover Sheet (Appendix A) of the proposal. In addition, a minimum of two-thirds of each Phase I SBIR project must be carried out by the proposing firm. For Phase II a minimum of one-half of the effort must be performed by the proposing firm. For both Phase I and II the primary employment of the principal investigator must be with the small business firm at the time of the award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the small business. Deviations from these requirements must be approved in writing by the contracting officer.

For both Phase I and Phase II the research or research and development work must be performed by the small business concern in the United States. "United States" means the fifty states, the Territories and possessions of the United States, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and the District of Columbia.

Joint ventures and limited partnerships are permitted, provided that the entity created qualifies as a small business in accordance with the Small Business Act. 15 USC 631, and the definition included in this solicitation.

1.5 Conflicts of Interest

Awards made to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees in violation of 18 USC and 10 USC 2397. Such proposers should contact the cognizant Ethics Counsellor of the DoD Component for further guidance.

1.6 Contact with DoD

a. Oral Communications. Oral communications with DoD Components regarding this solicitation during the Phase I proposal preparation periods are prohibited for reasons of competitive fairness, with the exceptions as stated in Section 1.6, 7.0, and Appendix D of this program solicitation.

b. Contacts for General Information of This Solicitation. General information questions pertaining to proposal instructions contained in this solicitation should be directed to:

Mr. Bob Wrenn
SBIR Coordinator
OSD/SADBU
U.S. Department of Defense
The Pentagon - Room 2A340
Washington, DC 20301-3061
(703) 697-1481

Other non-technical questions pertaining to a specific DoD Component should be directed in accordance with instructions given at the beginning of that DoD Component's topics in Appendix D of this solicitation.

c. Requests for Additional Copies of This Solicitation. Additional copies of this solicitation may be ordered from the Defense Technical Information Center: Attn: DTIC/SBIR, Building 5 Cameron Station, Alexandria, Virginia 22304-6415; telephone toll free (800) 368-5211 commercial for Virginia, Alaska and Hawaii (703) 274-6902.

2.0 DEFINITIONS

The following definitions apply for the purposes of this solicitation:

2.1 Research or Research and Development

Basic Research - A systematic, intensive study directed toward greater knowledge or understanding of the subject studied.

Exploratory Development - A systematic study directed specifically toward applying new knowledge to meet a recognized need.

Advanced Development or Engineering Development - A systematic application of knowledge towards the production of useful materials, devices and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

2.2 Small Business

A small business concern is one that, at the time of award of a Phase I or Phase II contract:

a. Is independently owned and operated and organized for profit, is not dominant in the field of operation in which it is proposing, and has its principal place of business located in the United States;

b. Is at least 51% owned or in the case of a publicly owned business, at least 51% of its voting stock is owned by United States citizens or lawfully admitted permanent resident aliens;

c. Has, including its affiliates, a number of employees not exceeding 500, and meets the other regulatory requirements found in 13 CFR 121. Business concerns, other than investment companies licensed, or state development companies qualifying under the Small Business Investment Act of 1958, 15 USC 661, et seq., are affiliates of one another when either directly or indirectly (1) one concern controls or has the power to control the other; or (2) a third party or parties controls or has the power to control both. Control can be exercised through common ownership, common management, and contractual relationships. The term "affiliates" is defined in greater detail in 13 CFR 121.3-2(a). The term "number of employees" is defined in 13 CFR 121.3-2(t). Business concerns include, but are not limited to, any individual, partnership, corporation, joint venture, association or cooperative.

2.3 Minority and Disadvantaged Small Business

A small business that is at the time of award of a Phase I or Phase II contract:

a. At least 51% owned by one or more minority and disadvantaged individuals; or, in the case of any publicly owned business, at least 51% of the voting stock of which is owned by one or more minority and disadvantaged individuals; and

b. Whose management and daily business operations are controlled by one or more of such individuals.

While these individuals and small concerns will be required to compete for SBIR on the same basis as all other small businesses, attention will be given to a special outreach effort to ensure that minority and disadvantaged firms will have notice of this solicitation.

A minority and disadvantaged individual is defined as a member of any of the following groups; Black Americans; Hispanic Americans; Native Americans; Asian-Pacific Americans; or subcontinent-Asian Americans.

2.4 Women-Owned Small Business

A women-owned small business is one that is at least 51% owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

2.5 Subcontract

A subcontract is any agreement, other than one involving an employer-employee relationship, entered into by a Federal Government contract awardee calling for supplies or services required solely for the performance of the original contract. This includes consultants.

3.0 PROPOSAL PREPARATIONS INSTRUCTIONS AND REQUIREMENTS

3.1 Proposal Requirements

A proposal to any DoD Component under the SBIR Program is to provide sufficient information to persuade the DoD Component that the proposed work represents an innovative approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria.

The quality of the scientific or technical content of the proposal will be the principal basis upon which proposals will be evaluated. The proposed research or research and development must be responsive to the technological innovation, new commercial products, process, or services which benefit the public.

Those responding to this solicitation should note the proposal preparation tips listed below:

· Read and follow all instructions contained in this solicitation; including those contained in Appendix D.

· Use the free technical information services from DTIC (Section 7.1) and also the free assistance available at the DCAS near you (Section 7.3) and your State organization listed in Reference E.

· Mark proprietary information as instructed in Section 5.5.

· Limit your proposal to 25 pages.

· Don't include proprietary or classified information in the project summary (Appendix B).

. Include a Red Copy of Appendix A and Appendix B as part of the Original of each proposal.

3.2 Proprietary Information

If information is provided which constitutes a trade secret, proprietary, commercial or financial information, confidential personal information, or data affecting the national security, it will be treated in confidence to the extent permitted by law, provided it is clearly marked in accordance with Section 5.5.

3.3 Limitations on Length of Proposal

This solicitation is designed to reduce the investment of time and cost to small firms in preparing a formal proposal. Those who wish to respond must submit a direct, concise and informative research or research and development proposal of no more than 25 pages, (no type smaller than elite or 12 pitch on standard 8½" X 11" paper with one (1) inch margins, 6 lines per inch) *including Proposal Cover Sheet (Appendix A), Project Summary (Appendix B), Cost Proposal (Appendix C), and any enclosures or attachments.* Promotional and non-project related discussion is discouraged. Cover all items listed below in Section 3.4 in the order given. The space allocated to each will depend on the problem chosen and the principal investigator's approach. In the interest of equity, no additional attachments, appendices or references beyond the 25 page limitation will be considered in proposal evaluation, and proposals in excess of the 25 page limitation *will not* be considered for review or award.

The proposal must address the research or research and development proposed on the specific topic chosen. It is not necessary to provide a lengthy discourse on the commercial applications in the Phase I proposal except to discuss briefly as described in Section 3.4, items b and h.

3.4 Phase I Proposal Format

All pages shall be consecutively numbered and the ORIGINAL of each proposal must contain a completed red copy of Appendix A and Appendix B.

a. Cover Sheet. Complete RED COPY of Appendix A, photocopy the completed form and use a copy as Page 1 of each additional copy of your proposal.

b. Project Summary. Complete RED COPY of Appendix B, photocopy the completed form and use a copy as Page 2 of each additional copy of your proposal. The technical abstract should include a brief description of the project objectives, and description of the effort. Anticipated benefits and commercial applications of the proposed research or research and development should also be summarized in the space provided. The Project Summary of successful proposals will be submitted for publication with unlimited distribution and, therefore, *will not* contain proprietary or classified information.

c. Identification and Significance of the Problem or Opportunity. Define the specific technical problem or opportunity addressed and its importance. (Begin on Page 3 of your proposal.)

d. Phase I Technical Objectives. Enumerate the specific objectives of the Phase I work, including the questions it will try to answer to determine the feasibility of the proposed approach.

e. Phase I Work Plan. Provide an explicit, detailed description of the Phase I approach. The plan should indicate what is planned, how and where the work will be carried out, a schedule of major events, and the final product to be delivered. Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal.

f. Related Work. Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, by the proposing firm, consultants, or others, how it interfaces with the proposed project, and any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic. Use of DTIC is encouraged.

Relationship with Future Research or Research and Development.

(1) State the anticipated results of the proposed approach if the project is successful.
(2) Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.

h. Potential Post Applications. Briefly describe:

(1) Whether and by what means the proposed project appears to have potential use by the Federal Government.
(2) Whether and by what means the proposed project appears to have potential commercial application.

i. Key Personnel. Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise resume of the principal investigator, including a list of relevant publications (if any), must be included.

j. Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in Appendix C) shall be justified under this Section. Also state whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name) and local governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

k. Consultants. Involvement of university or other consultants in the project may be appropriate. If such involvement is intended, it should be described in detail, and identified in Appendix C. A minimum of two-thirds of each Phase I SBIR project must be carried out by the proposing firm, unless otherwise approved in writing by the contracting officer.

l. Prior, Current or Pending Support. If a proposal submitted in response to this solicitation is substantially the same as another proposal that has been or is funded by, or is pending with another federal agency or DoD Component or the same DoD Component, the proposer must indicate action on Appendix A and provide the following information:

(1) Name and address of the federal agency(s) or DoD Component to which a proposal was submitted, or will be submitted or from which an award is expected or has been received.
(2) Date of proposal submission or date of award.
(3) Title of proposal.
(4) Name and title of principal investigator for each proposal submitted or award received.
(5) Title, number, and date of solicitation(s) under which the proposal was submitted or will be submitted or under which award is expected or has been received.
(6) If award was received, state contract number.
(7) Specify the applicable topics for each SBIR proposal submitted or award received.

Note: If Section 3.4.1 does not apply, state in the proposal "No prior, current or pending support for a similar proposal."

m. Cost Proposal. Complete the cost proposal in the form of Appendix C for the Phase I effort only. Some items of Appendix C may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item. What matters is that enough information be provided to allow the DoD Component to understand how the proposer plans to use the requested funds if the contract is awarded.

(1) List all key personnel by name as well as by number of hours dedicated to the project as direct labor.
(2) Special tooling and test equipment and material cost may be included under Phases I and II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the government and should be related directly to the specific topic. These may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the government or acquired with government funds, will be vested with the DoD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.
(3) Cost for travel funds must be justified and related to the needs of the project.
(4) Cost sharing is permitted for proposals under this solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

3.5 Bindings

Do not use special bindings or cover. Staple the pages in the upper left hand corner of each proposal.

3.6 Phase II Proposal

A Phase II proposal can be submitted only by a Phase I awardee. Phase II is not initiated by a solicitation, but a proposal must contain a Cover Sheet (Appendix A) and a Project Summary Sheet (Appendix B) of this solicitation. Copies of Appendixes along with instructions regarding Phase II proposal preparation and submission will be provided by the DoD Components to all Phase I winners at time of Phase I contract award.

4.0 METHOD OF SELECTION AND EVALUATION CRITERIA

4.1 Introduction

Phase I proposals will be evaluated on a competitive basis and will be considered to be binding for six (6) months from the date of closing of this solicitation unless offeror states otherwise. If selection has not been made prior to the proposal's expiration date, offerors will be requested as to whether or not they want to extend their proposal for an additional period of time. Proposals meeting stated solicitation requirements will be evaluated by scientists or engineers knowledgeable in the topic area. Proposals will be evaluated first on their relevance to the chosen topic. Those found to be relevant will then be evaluated using the criteria listed in Section 4.2. Final decisions will be made by the DoD Component based upon these criteria and consideration of other factors, including possible duplication of other work, and program balance. A DoD Component may elect to fund several or none of the proposed approaches to the same topic. In the evaluation and handling of proposals, every effort will be made to protect the confidentiality of the proposal and any evaluations. There is no commitment by the DoD Components to make any awards on any topic, to make a specific number of awards or to be responsible for any monies expended by the proposer before award of a contract.

For proposals that have been selected for contract award, a Government Contracting Officer will draw up an appropriate contract to be signed by both parties before work begins. Any negotiations that may be necessary will be conducted between the offeror and the Government Contracting Officer. It should be noted that only a duly appointed contracting officer has the authority to enter into a contract on behalf of the U.S. Government.

Phase II proposals will be subject to technical review process similar to Phase I. Final decisions will be made by DoD Components based upon the scientific and technical evaluations and other factors, including a commitment for Phase III follow-on funding, the possible duplication with other research, or research and development, program balance, budget limitations and the potential of a successful Phase II effort leading to a product of continuing interest to DoD.

Upon written request and after final award decisions have been announced a debriefing will be provided to unsuccessful offerors, on their proposals.

4.2 Evaluation Criteria - Phase I

The DoD Components plan to select for award those proposals offering the best value to the government with approximately equal consideration given to each of the following criteria, except for item a., which will receive twice the weight of any other item.

a. Scientific/technical quality of the Phase I research or research and development proposal and its relevance to the topic description, with special emphasis on its innovation and originality.

b. Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities.

c. Anticipated benefits of the research or research and development to the total DoD research and development effort.

d. Adequacy of the Phase I proposed effort to show progress toward demonstrating the feasibility of the concept.

Where technical evaluations are essentially equal in merit, cost to the government will be considered in determining the successful offeror.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referred to experiments. Relevant supporting data such as journal articles, literature, including government publications, etc., should be contained or referenced in the proposal.

4.3 Evaluation Criteria - Phase II

The Phase II proposal will be reviewed for overall merit based upon the criteria below. Each item will receive approximately equal weight, except for item a., which will receive twice the value of any other item:

a. Anticipated benefits of the research or development to the total DoD research and development effort.

b. Scientific/technical quality of the proposal, with special emphasis on its innovation and originality.

c. Qualifications of the principal investigator and other key personnel to carry out the proposed work.

d. Degree to which the Phase I objectives were met at the time of Phase II proposal submission.

e. Adequacy of the Phase II objectives to meet the opportunity or solve the problem.

The reasonableness of the proposed costs of the effort to be performed will be examined to determine those proposals that offer the best value to the government. Where technical evaluations are essentially equal in merit, cost to the government will be considered in determining the successful offeror.

In the case of proposals of approximately equal merit, the provision of a follow-on Phase III funding commitment for a continued development from non-federal funding sources will be a special consideration. The follow-on funding commitment must provide that a specific amount of Phase III funds will be made available to or by the small business and indicate the dates the funds will be made available. It must also contain specific technical objectives which, if achieved in Phase II, will make the commitment exercisable by the small business. The terms cannot be contingent upon the obtaining of a patent due to the length of time this process requires. The funding commitment shall be submitted with the Phase II proposal.

Phase II proposal evaluation may include on-site evaluations of the Phase I effort by government personnel.

5.0 CONTRACTUAL CONSIDERATIONS

Note: Eligibility and Limitation Requirements (Section 1.4) Will Be Enforced

5.1 Awards (Phase I)

a. Number of Phase I Awards. The number of Phase I awards will be consistent with the agency's RDT&E budget, the number of anticipated awards for interim Phase I modifications, and Phase II contracts. No Phase I contracts will be awarded until all qualified proposals (received in accordance with Section 6.2) on a specific topic have been evaluated. All proposers will be notified of selection/non-selection status for a Phase I award no later than January 2, 1992. The name of those firms selected for awards will be announced. *The DoD Components anticipate making 1300 Phase I awards during Fiscal Year 1991.*

b. Type of Funding Agreement. All winning proposals will be funded under negotiated contracts and may include a fee or profit. The firm fixed price or cost plus fixed fee type contract will be used for all Phase I projects. *Note: The firm fixed price contract is the preferred type for Phase I.*

c. Average Dollar Value of Awards. DoD Components will make Phase I awards to small businesses typically on one-half person-year effort over a period generally not to exceed six months, *subject to negotiation.* The legislative history of PL 97-219 and PL 99-443 clearly envisioned a large number of Phase I awards up to $50,000 each, *adjusted for inflation.*

5.2 Awards (Phase II)

a. Number of Phase II Awards. The number of Phase II awards will depend upon the results of the Phase I efforts and the availability of funds. *The DoD Components anticipate making 450 Phase II awards during Fiscal Year 1991.*

b. Type of Funding Agreement. Each Phase II proposal selected for award will be funded under a negotiated contract and may include a fee or profit.

c. Project Continuity. Phase II proposers who wish to maintain project continuity must submit proposals no later than 30 days prior to the expiration date of the Phase I contract and must identify in their proposal the work to be performed for the first four months of the Phase II effort and the costs associated therewith. *These Phase II proposers may be issued a modification to the Phase I contract, at the discretion of the government,* covering an interim period not to exceed four months for preliminary Phase II work while the total Phase II proposal is being evaluated and a contract is negotiated. This modification would normally become effective at the completion of Phase I or as soon thereafter as possible. Funding, scope of work, and length of performance for this interim period will be subject to negotiations. Issuance of a contract modification for the interim period does not commit the government to award a Phase II contract.

d. Average Dollar Value of Awards. Phase II awards will be made to small businesses based on results of the Phase I efforts and the scientific and technical merit of the Phase II proposal. Average Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months, *subject to negotiation.* The legislative history of PL 97-219 and PL 99-443 clearly envisioned that the Phase II awards would be up to $500,000 each, *adjusted for inflation.*

5.3 Reports

SIX COPIES of a final report on the Phase I project must be submitted to the DoD Component in accordance with the negotiated delivery schedule. This will normally be within thirty days after completion of the Phase I technical effort. The final report shall include a completed SF 298, "*Report Documentation Page*" as the first page identifying the purpose of the work, a brief description of the work carried out, the findings or results, and potential applications of the effort. The summary may be published by DoD and therefore must not contain proprietary or classified information. The balance of the report should indicate in detail the project objectives, work carried out, results obtained, and estimates of technical feasibility.

To avoid duplication of effort, language used to report Phase I progress in a Phase II proposal, if submitted, may be used verbatim in the final report with changes only to accommodate results obtained after Phase II proposal submission, and modifications required to integrate the final report into a self-contained, comprehensive and logically structured document.

5.4 Payment Schedule

The specific payment schedule (including payment amounts) for each contract will be incorporated into the contract upon completion of negotiations between the DoD and the successful Phase I offeror. Successful offerors may be paid periodically as work progresses in accordance with the negotiated price and payment schedule. Phase I contracts are primarily fixed price contracts, under which monthly progress payments may be made up to 85% of the contract price excluding fee or profit. The contract may include a separate provision for payment of a fee or profit. Final payment will follow completion of contract performance and acceptance of all work required under the contract. Other types of financial assistance may be available under the contract.

5.5 Markings of Proprietary or Classified Proposal Information

The proposal submitted in response to this solicitation may contain technical and other data which the proposer does not want disclosed to the public or used by the government for any purpose other than proposal evaluation.

Information contained in unsuccessful proposals will remain the property of the proposer except for Appendixes A and B. The government may, however, retain copies of all proposals. Public release of information in any proposal submitted will be subject to existing statutory and regulatory requirements.

If proprietary information is provided by a proposer in a proposal which constitutes a trade secret, proprietary commercial or financial information, confidential personal information or data affecting the national security, it will be treated in confidence, to the extent permitted by law, provided this information is clearly marked by the proposer with the term *"confidential proprietary information"* and provided that the following legend appears on the title page (Appendix A) of the proposal:

"For any purpose other than to evaluate the proposal, this data except Appendix A and B shall not be disclosed outside the government and shall not be duplicated, used, or disclosed in whole or in part, provided that if a contract is awarded to the proposer as a result of or in connection with the submission of this data, the government shall have the right to duplicate, use or disclose the data to the extent provided in the contract. This restriction does not limit the government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained in page(s)_____of this proposal."

Any other legend may be unacceptable to the government and may constitute grounds for removing the proposal from further consideration and without assuming any liability for inadvertent disclosure. The government will limit dissemination of properly marked information to within official channels.

In addition, each page of the proposal containing proprietary data which the proposer wishes to restrict must be marked with the following legend:

> "Use or disclosure of the proposal data on lines specifically identified by asterisk (*) are subject to the restriction on the cover page of this proposal."

The government assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

In the event properly marked data contained in a proposal in response to this solicitation is requested pursuant to the Freedom of Information Act, 5 USC 552, the proposer will be advised of such request and prior to such release of information will be requested to expeditiously submit to the DoD Component a detailed listing of all information in the proposal which the proposer believes to be exempt from disclosure under the Act. Such action and cooperation on the part of the proposer will ensure that any information released by the DoD Component pursuant to the Act is properly determined.

Those proposers that have a classified facility clearance may submit classified material with their proposal. Any classified material shall be marked and handled in accordance with applicable regulations. Arbitrary and unwarranted use of this restriction is discouraged. Offerors must follow the Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M) procedures for marking and handling classified material.

5.6 Copyrights

To the extent permitted by statute, the awardee may copyright (consistent with appropriate national security considerations, if any) material developed with DoD support. DoD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgement and disclaimer statement.

5.7 Patents

Small business firms normally may retain the principal worldwide patent rights to any invention developed with government support. The government receives a royalty-free license for its use, reserves the right to require the patent holder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 USC 205, the government will not make public any information disclosing a government-supported invention for a reasonable time period to allow the awardee to pursue a patent.

5.8 Technical Data Rights

Rights in technical data, including software, developed under the terms of any contract resulting from proposals submitted in response to this solicitation shall remain with the contractor, except that the government shall have the limited right to use such data for government purposes and shall not release such data outside the government without permission of the contractor for a period of two years from completion of the project from which the data was generated unless the data has already been released to the general public. However, effective at the conclusion of the two-year period, the government shall retain a royalty-free license for government use of any technical data delivered under an SBIR contract whether patented or not.

5.9 Cost Sharing

Cost sharing is permitted for proposals under this solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

5.10 Joint Ventures or Limited Partnerships

Joint ventures and limited partnerships are eligible provided the entity created qualifies as a small business as defined in Paragraph 2.2 of this solicitation.

5.11 Research and Analytical Work

a. For Phase I a minimum of two-thirds of the research and/or analytical effort must be performed by the proposing firm unless otherwise approved in writing by the contracting officer.

b. For Phase II a minimum of one-half of the research and/or analytical effort must be performed by the proposing firm.

5.12 Contractor Commitments

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions required by the Federal Acquisition Regulations that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. Copies of complete general provisions will be made available prior to award.

a. Standards of Work. Work performed under the contract must conform to high professional standards.

b. Inspection. Work performed under the contract is subject to government inspection and evaluation at all reasonable times.

c. Examination of Records. The Comptroller General (or a fully authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.

d. Default. The government may terminate the contract if the contractor fails to perform the work contracted.

e. Termination for Convenience. The contract may be terminated at any time by the government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.

f. Disputes. Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.

g. Contract Work Hours. The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay.)

h. Equal Opportunity. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

i. Affirmative Action for Veterans. The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran or veteran of the Vietnam era.

j. Affirmative Action for Handicapped. The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.

k. Officials Not to Benefit. No member of or delegate to Congress shall benefit from the contract.

l. Covenant Against Contingent Fees. No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bonafide employees or commercial agencies maintained by the contractor for the purpose of securing business.

m. Gratuities. The contract may be terminated by the government if any gratuities have been offered to any representative of the government to secure the contract.

n. Patent Infringement. The contractor shall report each notice or claim of patent infringement based on the performance of the contract.

o. Military Security Requirements. The contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.

5.13 Additional Information

a. General. This Program Solicitation is intended for information purposes and reflects current planning. If there is any inconsistency between the information contained herein and the terms of any resulting SBIR contract, the terms of the contract are controlling.

b. Small Business Data. Before award of an SBIR contract, the government may request the proposer to submit certain organizational, management, personnel and financial information to confirm responsibility of the proposer.

c. Proposal Preparation Costs. The government is not responsible for any monies expended by the proposer before award of any contract.

d. Government Obligations. This Program Solicitation is not an offer by the government and does not obligate the government to make any specific number of awards. Also awards under this program are contingent upon the availability of funds.

e. Unsolicited Proposals. The SBIR Program is not a substitute for existing unsolicited proposal mechanisms. Unsolicited proposals will not be accepted under the SBIR Program in either Phase I or Phase II.

f. Duplication of Work. If an award is made pursuant to a proposal submitted under this Program Solicitation, the contractor will be required to certify that he or she has not previously been, nor is currently being, paid for essentially equivalent work by an agency of the Federal Government.

g. Classified Proposals. If classified work is proposed or classified information is involved, the offeror to the solicitation must have, or obtain, security clearance in accordance with the Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M).

6.0 SUBMISSION OF PROPOSALS

An original plus (4) copies of each proposal or modification will be submitted, in a single package, as described below, unless otherwise stated by specific instructions in Appendix D.
NOTE: THE ORIGINAL OF EACH PROPOSAL MUST CONTAIN A COMPLETED RED COPY OF APPENDIX A (COVER SHEET) AND APPENDIX B (PROJECT SUMMARY).

6.1 Address

Each proposal or modification package must be addressed to that DoD Component address which is identified for the specific topic in that Component's section of Appendix D to this solicitation.

The name and address of the offeror, the solicitation number and the topic number for the proposal must be clearly marked on the face of the envelope or wrapper.

Mailed or handcarried proposals must be delivered to the address indicated for each topic. Secure packaging is mandatory. The DoD Component cannot be responsible for the processing of proposals damaged in transit.

All copies of a proposal must be sent in the same package. Do not send separate information copies or several packages containing parts of the single proposal.

6.2 Deadline for Proposals

Deadline for receipt of proposals at the DoD Component is 2:00 p.m. local time, July 1, 1991. Any proposal received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before an award is made, and: (a) it was sent by registered or certified mail not later than June 24, 1991 or (b) it was sent by mail and it is determined by the government that the late receipt was due solely to mishandling by the government after receipt at the government installation.

Note: There are no other provisions for late receipt of proposals under this solicitation.

The only acceptable evidence to establish (a) the date of mailing of a late received proposal sent either by registered mail or certified mail is the U. S. Postal Service postmark on the wrapper or on the original receipt from the U. S. Postal Service. If neither postmark shows a legible date, the proposal shall be deemed to have been mailed late. The term postmark means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed on the date of mailing by employees of the U. S. Postal Service. Therefore, offerors should request the postal clerk to place a hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper; (b) the time of receipt at the government installation is the time-date stamp of such installation on the proposal wrapper or other documentary evidence of receipt maintained by the installation.

Proposals may be withdrawn by written notice or a telegram received at any time prior to award. Proposals may also be withdrawn in person by an offeror or his authorized representative, provided his identity is made known and he signs a receipt for the proposal. (NOTE: the term telegram includes mailgrams.)

Any modification or withdrawal of a proposal is subject to the same conditions outlined above. Any modification may not make the proposal longer than 25 pages. Notwithstanding the above, a late modification of an otherwise successful proposal which makes its terms more favorable to the government will be considered at any time it is received and may be accepted.

6.3 Notification of Proposal Receipt

Proposers desiring notification of receipt of their proposal must complete and include a self-addressed stamped er 'ope and a copy of the notification form (Reference L, in the back of this brochure. If multiple proposals are submitted, a separate form and envelope is required for each. Notification of receipt of a proposal by the government does not by itself constitute a determination that the proposal was received on time or not. The determination of timeliness is solely governed by the criteria set forth in Section 6.2.

6.4 Information on Proposal Status

Evaluation of proposals and award of contracts will be expedited, but no information on proposal status will be available until the final selection is made. However, contracting officers may contact any and all qualified proposers prior to contract award.

6.5 Debriefing of Unsuccessful Offerors

Upon written request and after final award decisions have been announced a debriefing will be provided to unsuccessful offerors for their proposals.

6.6 Correspondence Relating to Proposals

All correspondence relating to proposals should cite the SBIR solicitation number, specific topic number and be addressed to the DoD Component whose address is associated with the specific topic number.

7.0 SCIENTIFIC AND TECHNICAL INFORMATION ASSISTANCE

7.1 DoD Technical Information Services Available

Recognizing that small business may not have strong technical information service support, the Defense Technical Information Center (DTIC) is prepared to give special attention to the needs of DoD SBIR Program participants.

DTIC is the central source of scientific and technical information resulting from and describing R&D projects that are funded by DoD. DTIC searches this information for registered requesters. Reasonable quantities of paper or microfiche copies of requested documents are available for SBIR Program proposal preparation.

DTIC will also provide referrals to DoD sponsored Information Analysis Centers (IACs) where specialists in mission areas assigned to these IACs perform informational and consultative services.

Many of the small business requesters who responded to previous DoD SBIR Program solicitations believe that the scientific and technical information which DTIC provided enabled them to make better informed bid/no bid decisions and prepare technically stronger proposals. People responding to this solicitation are encouraged to contact DTIC for bibliographies of technical reports that have resulted from prior DoD funded R&D, for copies of the technical reports which are cited in these bibliographies, and for information about DoD sponsored work currently in progress in their proposal topic areas.

DTIC assistance will include references to other sources of scientific and technical information needed to prepare SBIR Program proposals to DoD. Call or visit DTIC at the following location which is most convenient to you.

All written communications with DTIC must be made to the Cameron Station, Alexandria, VA address.

Defense Technical Information Center
ATTN: DTIC-SBIR
Building 5, Cameron Station
Alexandria, VA 22304-6145
(800) 368-5211 (toll free)
(703) 274-6902 (Commercial for Virginia, Alaska and Hawaii)

DTIC Boston On-Line Service Facility
DTIC-BOS
Building 1103, Hanscom AFB
Bedford, MA 01731-5000
(617) 377-2413

DTIC Albuquerque Regional Office
AFWL/SUL Bldg. 419
Kirtland AFB, NM 87117-6008
(505) 846-6797

DTIC Los Angeles On-Line Service Facility
Defense Contract Administration Services Region
222 N. Sepulveda Blvd.
El Segundo, CA 90245-4320
(213) 335-4170

Use Reference C at the back of this solicitation or telephone DTIC to request background bibliographies and descriptions of work in progress related to those topic areas which you plan to pursue under this solicitation. DTIC will return the material you request, annotated with a temporary User Code. This User Code is to be used by you when requesting additional information or when ordering documents cited in a bibliography until the solicitation closing date.

Because solicitation response time is limited, submit your requests for DTIC's information services as soon as possible. *To assure the fastest possible mail service, give DTIC your Federal Express Account Number to which mailing charges will be made for overnight delivery.*

7.2 Other Technical Information Assistance Sources

Other sources provide technology search and/or document services and can be contacted directly for service and cost information. These include:

Aerospace Research Applications Center
P.O. Box 647
Indianapolis, IN 46223
(317) 264-4644

Central Industrial Applications Center
Southeastern Oklahoma State University
Durant, OK 74701
(405) 924-6822

Information Strategists
814 Elm Street
Manchester, NH 03101
(603) 624-8208

NASA/Florida State Technology Applications Center
State University System of Florida, Progress Center
1 Progress Blvd., Box 24
Alachua, FL 32615
(904) 462-3913

NASA Industrial Applications Center
823 William Pitt Union
University of Pittsburgh
Pittsburgh, PA 15260
(412) 648-7000

NASA/UK Technology
University of Kentucky
109 Kinkead Hall
Lexington, KY 40506
(606) 257-6322

NERAC, Inc.
1 Technology Drive
Tolland, CT 06084
(203) 872-7000

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4600

North Carolina Science and Technology Research Center
P.O. Box 12235
Research Triangle Park, North Carolina 27709
(919) 549-0671

Western Research Applications Center (WESRAC)
University of Southern California
3716 S. Hope Street #200
Los Angeles, California 90007
(213) 743-6132

7.3 DOD Counseling Assistance Available

Small business firms interested in participating in the SBIR Program may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States. These specialists are available to discuss general administrative requirements to facilitate the submission of proposals and ease the entry of the small high technology business into the Department of Defense marketplace. The small and disadvantaged business utilization specialists are expressly prohibited from taking any action which would give an offeror an unfair advantage over others, such as discussing or explaining the technical requirements of the solicitation, writing or discussing technical or cost proposals, estimating cost or any other actions which are the offerors responsibility as outlined in this solicitation. (See Reference D at the end of this solicitation for a complete listing, with telephone numbers, of Small and Disadvantaged Business Utilization Specialists assigned to these activities.)

7.4 State Assistance Available

Many states have established programs to provide services to those small firms and individuals wishing to participate in the Federal SBIR Program. These services vary from state to state, but may include:

- Information and technical assistance
- Matching funds to SBIR receipients
- Assistance in obtaining Phase III funding

Reference E contains a listing of States with established SBIR organizations known to the DOD SBIR Coordinator.

8.0 TECHNICAL TOPICS

Topics for each DoD Component are listed and numbered separately. Topics, topic descriptions, and addresses of organizations to which proposals are to be submitted are provided in Appendix D. Also included in Appendix D are special instructions for contacting and submitting preposals to each DoD Component.

U.S. ARMY

INTRODUCTION

We have focused many of these new SBIR initiatives on the thirteen Army Key Emerging Technologies in concert with the Army Technology Base Master Plan.

These technology areas are:

-Advanced Materials and Materials Processing
-Microelectronics, Photonics and Acoustics
-Advanced Signal Processing and Computing
-Artificial Intelligence
-Robotics
-Advanced Propulsion Technology
-Power Generation, Storage and Conditioning
-Directed Energy
-Space Technology
-Low Observable Technology
-Protection/Lethality
-Biotechnology
-Neuroscience Technology

We plan to make about 224 awards in the fall of this year. These selections will be made by the office where you send your proposal. Refer to the Point of Contact page for additional information. We again urge you to view the Phase I proposal as a feasibility concept and to tailor your costs to the $50,000 ceiling. Also you are reminded to contact the Defense Technical Information Center at 1-800-368-5211 for relevant technical reports. Good Luck and Thank You for participating in the Army SBIR Program.

J. Patrick Forry
Army SBIR Program Manager
Army Material Command
Alexandria, Virginia

ARMY SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Submitting Proposals on Army Topics

Phase I proposal (5 copies including 1 red-printed form) should be addressed to:

Point of Contact

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ARDEC)
Topic Nos. A91-031 through A91-042 — G. Magistro, (201) 724-7349

Commander
U.S. Army Armament RD&E Center
ATTN: SMCAR-AST
Bldg. 1, SBIR Program
Picatinny Arsenal, NJ 07806-5000

BELVOIR RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (BRDEC)
Topic Nos. A91-043 through A91-045 — C. Harrison, (703) 664-1068

Mail address:
Commander
U.S. Army Belvoir RD&E Center
ATTN: AMSTR-PBP, SBIR Program
Bldg 314, Procurement Receptionist
Ft. Belvoir, VA 22060-5606

Handcarry address:
U.S. Army Belvoir RD&E Center
ATTN: STRBE-IL (C. Harrisson)
Bldg. 312, Rm. 116
Ft. Belvoir, VA 22060-5606

COMMUNICATION ELECTRONICS COMMAND (CECOM)
Topic Nos. A91-046 through A91-047 — J. Crisci, (201) 544-2665

Director
U.S. Army Center for Night Vision & Electro-Optics
ATTN: AMSEL-RD-NV-RM-FP, SBIR Program
Bldg. 305, Linda Kline
Ft. Belvoir, VA 22060-5677

Topic Nos. A91-048 through A91-051

Director
U.S. Army Center for Signals Warfare
ATTN: AMSEL-RD-SW-DTI, SBIR Program
Bldg. 260, Linda Monroe
Vint Hill Farms Station
Warrenton, VA 22186-5100

Topic Nos. A91-052 through A91-064

Commander
U.S. Army Communications-Electronics Command
ATTN: AMSEL-PCCC-BID, SBIR Program
Wayside Raod and Tinton Ave. (Intersection)
Ft. Monmouth, NJ 07703-5000

CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING CENTER (CRDEC)
Topic Nos. A91-065 through A91-073 — R. Hinkle

Commander
U.S. Army Chemical Research, Development and Engineering Center
ATTN: AMSMC-PC-B(A) Procurement Directorate
Bldg. 4455, SBIR Program
Edgewood Site
Aberdeen Proving Ground, MD 21010-5423

(301) 671-2031

MISSILE COMMAND (MICOM)

Topic Nos. A91-074 through A91-087

J. Fulda
(205) 876-2811

Commander
U.S. Army Missile Command
ATTN: AMSMI-PC-FB
Bldg. 4488, SBIR Program
Redstone Arsenal, AL 01760-5011

NATICK RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (NATICK)

Topic Nos. A91-088 through A91-096

R. Rosenkrans
(508) 651-5296

Commander
U.S. Army Natick RD&E Center
ATTN: AMSTR-PW, SBIR Program
Natick, MA 01760-5011

TANK-AUTOMOTIVE COMMAND (TACOM)

Topic Nos. A91-097 through A91-108

R. Hostetler
(313) 574-5270

Commander
U.S. Army Tank-Automotive Command
ATTN: AMSTA-IRSA
Bldg. 200A, SBIR Program
Warren, MI 48397-5000

TEST AND EVALUATION COMMAND (TECOM)

Topic Nos. A91-109 through A91-111

R. Cozby
(301) 278-7883

Commander
U.S. Army White Sands Missile Range
Directorate of Contracting
ATTN: STEWS-PR, SBIR Program
Bldg. 126
White Sands Missile Range, NM 88002-5201

Topic No. A91-112

Commander
U.S. Army Yuma Proving Ground
Directorate of Contracting
ATTN: STEYP-CR, SBIR Program
Bldg. 2100, Rm 11
Yuma, AZ 85365-9102

Topic Nos. A91-113 through A91-114

Commander
U.S. Army Electronic Proving Ground
ATTN: STEEP-MO, SBIR Program

Greely Hall
Ft. Huachuca, AZ 85613-7110

Topic Nos. A91-115 through A91-116
Commander
U.S. Army Aberdeen Proving Ground Support Activity
Directorate of Contracting
ATTN: STEAP-PR-S, SBIR Program
Ryan Bldg., Rm 124
Aberdeen Proving Ground, MD 21005-5001

LABORATORY COMMAND

Ballistics Research Laboratory (BRL) — R. Dimmick
Dimmick
Topic Nos. A91-117 through A91-122 — (301) 278-6955
Director
U.S. Army Armament, Munitions and Chemical Command
Procurement Directorate
ATTN: AMCMC-PCM(A), SBIR Program (BRL)
Edgewood Site, Bldg. E4455
Aberdeen Proving Ground, MD 21010-5423

Army Research Office (ARO) — W. Sander
Topic Nos. A91-123 through A91-129 — (919) 549-0641
Commander
U.S. Army Research Office
ATTN: SLCRO-RT, SBIR Program (ARO)
PO Box 12211
4300 S. Miami Blvd.
Research Triangle Park, NC 27709-2211

Atmospheric Science Laboratory (ASL) — O. Johnson
Topic Nos. A91-130 through A91-132 — (505) 678-3608
Commander
U.S. Army White Sands Missile Range
Directorate of Contracting
ATTN: STEWS-PR, SBIR Program (ASL)
Building 126
White Sands Missile Range, NM 88002-5031

Electronics Technology & Devices Laboratory (ETDL) — R. Stern
Topic Nos. A91-133 through A91-147 — (201) 544-4666
Director
U.S. Army Electronics Technology and Devices Laboratory
ATTN: SLCET-DT, SBIR Program (ETDL)
Ft. Monmouth, NJ 07703-5000

Human Engineering Laboratory (HEL) — J. Sissum
Topic Nos. A91-148 through A91-151 — (301) 278-5815
Commander
U.S. Army Armament, Munitions and Chemical Command
Procurement Directorate

ATTN: AMCMC-PCA(A), SBIR Program (HEL)
Edgewood Site, Bldg. E4455
Aberdeen Proving Ground, MD 21010-5423

Harry Diamond Laboratories (HDL) — D. Hudson
Topic Nos. A91-152 through A91-162 — (301) 394-2530
Director
Harry Diamond Laboratories (HDL)
ATTN: SLCHD-PO-AM (D. Hudson)
2800 Powder Mill Rd.
Adelphi, MD 20783-1197

Materials Technology Laboratory (MTL) — R. Morrissey
Topic Nos. A91-163 through A91-172 — (617) 923-5522
Director
U.S. Army Materials Technology Laboratory
ATTN: SLCMT-TMT, SBIR Program (MTL)
405 Arsenal Street
Bldg. 131, Rm 144
Watertown, MA 02172-2719

Vulnerability Assessment Laboratory (VAL) — D. Hemingway
Topic No. A91-173 — (505) 678-5766
Director
U.S. Army White Sands Missile Range
Vulnerability Assessment Laboratory
Directorate of Contracting
ATTN: STEWS-PR, SBIR Program (VAL)
White Sands Missile Range, NM 88002-5031

AVIATION SYSTEMS COMMAND (AVSCOM)
Topic Nos. A91-174 through A91-195 — R. Warhover
Commander — (314) 263-1082
U.S. Army Aviation Systems Command
ATTN: AMSAV-PSLZ, SBIR Program
4300 Goodfellow Blvd., Bldg. 102
St. Louis, MO 63120-1798

ARMY CORPS OF ENGINEERS
U.S. Army Construction Engineering Research Laboratory (CERL) — D. Moody
Topic Nos. A91-196 through A91-199 — (217) 373-7205
Commander
U.S. Army Construction Engineering Research Laboratory
ATTN: Chief, Procurement & Supply Branch
2909 Newmark Drive
Bldg 1., Rm 175-1, SBIR Program (CERL)
Champaign, IL 61820-1305

U.S. Army Engineer Topographic Laboratories (ETL) — J. Jamieson
Topic Nos. A91-200 through A91-205 — (703) 355-2631
Commander
U.S. Army Engineer Topographic Laboratories
ATTN: CEETL-PM, SBIR Program (ETL)
Building 2592, Leaf Road
Ft. Belvoir, VA 22060-5546

U.S. Army Engineer Waterways Experiment Station
Topic No. A91-206
Commander
U.S. Army Engineer Waterways Experiment Station
ATTN: CEWES-BC, SBIR Program (WES)
P.O. Box 631
Vicksburg, MS 39180-0631

P. Stewart
(601) 634-4113

ARMY RESEARCH INSTITUTE (ARI)
Topic Nos. A91-207 through A91-210
Commnader
U.S. Army Research Institute for Behavioral and Social Sciences
ATTN: PERI-BR, SBIR Program (ARI)
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

M. Drillings
(703) 274-5572

ARMY MEDICAL RESEARCH ACQUISITION ACTIVITY (MEDICAL)
Topic Nos. A91-211 through A91-231
Commander
U.S. Army Medical Research Acquisition Activity
ATTN: SGRD-RMA-RC, SBIR Program
Ft. Detrick, Bldg. 820
Frederick, MD 21701-5014

A. Wolf
(301) 663-7216

STRATEGIC DEFENSE COMMAND (SDC)
Topic Nos. A91-232 through A91-247
Commander
U.S. Army Strategic Defense Command
ATTN: CSSD-H-CRT, SBIR Program (SDC)
P.O. Box 1500
106 Wynn Drive
Huntsville, AL 35807-3801

D. Satterfield
(205) 955-4816

PROJECT MANAGEMENT FOR TRAINING DEVICES (PM TRADE)
Topic Nos. A91-248 through A91-255
Naval Training Systems Center
Attn: Code 631
12350 Research Parkway
Orlando, FL 32826

A. Piper
(407) 380-4287

ARMY SBIR PROGRAM
POINTS OF CONTACT SUMMARY

A91-031/A91-042	ARDEC	G. MAGISTRO	201-724-7349
A91-043/A91-045	BRDEC	C. HARRISSON	703-664-1068
A91-046/A91-064	CECOM	J. CRISCI	201-544-2665
A91-065/A91-073	CRDEC	R. HINKLE	301-671-2031
A91-074/A91-087	MICOM	J. FULDA	205-876-2811
A91-088/A91-096	NATICK	R. ROSENKRANS	508-651-5296
A91-097/A91-108	TACOM	R. HOSTETLER	313-574-5270
A91-109/A91-116	TECOM	R. COZBY	301-278-7883
A91-117/A91-122	BRL	R. DIMMICK	301-278-6955
A91-123/A91-129	ARO	W. SANDER	919-549-0641
A91-130/A91-132	ASL	O. JOHNSON	505-678-3608
A91-133/A91-147	ETDL	R. STERN	201-544-4666
A91-148/A91-151	HEL	J. SISSUM	301-278-5815
A91-152/A91-162	HDL	D. HUDSON	301-394-2530
A91-163/A91-172	MTL	R. MORRISSEY	617-923-5522
A91-173	VAL	D. HEMINGWAY	505-678-5766
A91-174/A91-195	AVSCOM	R. WARHOVER	314-263-1082
A91-196/A91-199	CERL	D. MOODY	217-373-7205
A91-200/A91-205	ETL	J. JAMIESON	703-355-2631
A91-206	WES	P. STEWART	601-634-4113
A91-207/A91-210	ARI	M. DRILLINGS	703-274-5572
A91-211/A91-231	MEDICAL	A. WOLF	301-663-7216
A91-232/A91-247	SDC	D. SATTERFIELD	205-955-4816
A91-247/A91-255	PM TRADE	A. PIPER	407-380-4287

SUBJECT/WORD INDEX TO THE ARMY SBIR SOLICITATION

U.S. ARMY
FY1991 SBIR TOPIC INDEX

the Surfaces of Individual Equipment
A91-070 Investigation of Various Sprayer/Applicator Approaches for Dispersing Powdered Sorbents to Contaminated Surfaces
A91-071 Development of a Compact Raman Spectroscopy System for Chemical Contamination Monitoring
A91-072 Continuous Unattended Air Monitoring
A91-073 Development of Chemical Sensor System Capable of Automatic, Long Term Monitoring of Chemical Agents at Very Low Concentrations

U.S. ARMY MISSILE COMMAND

A91-074 Deformable Mirror Spatial Light Modulator Based Infrared Projector for Hardware-in-the-Loop Simulation Applications
A91-075 Improved Performance Integrated Optics Components for Fiber Gyroscopes
A91-076 Multipath Suppression Techniques
A91-077 Integrated Autonomous Target Acquisition System
A91-078 Dynamic Precision Phase/Amplitude Controller
A91-079 Development of a Compact Hardened Dye Laser
A91-080 Non-Intrusive Technique for the Measurement of Fluctuating Density, Temperature, and Species Concentration in Turbulent Supersonic Flows
A91-081 Thrust Augmentation System for Low Cost Expendable Turbojet Engine
A91-082 Infrared Wavelength Beam Combining Techniques for Multi-Color Projector Application
A91-083 Incorporating Digital Modulation into a Digital RF Memory System
A91-084 Infrared Laser Diode Based Infrared Projector
A91-085 Sensor Fusion for Detection Cueing and Classifiecation of Airborne and Ground Targets
A91-086 Remote Sensor for Surveillance and Data Collection
A91-087 Advanced Kinetic Energy Penetrator Concepts for Kinetic Energy Missiles

U.S. ARMY NATICK RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

A90-088 Thermoplastic Elastomer (TPE) Coated Fabric for Toxicological Agents Protective (TAP) Suit
A90-089 Three Year Shelf Life, High Barrier Food Container
A90-090 Shape Memory/Smart Materials for Stiffened Fabric Wings
A90-091 Manufacture of Superactivated Carbon
A90-092 Binary Food Heating/Cooling Container
A90-093 Thermoplastic Elastomer (TPE) Chemical Protective (CP) Gloves By Injection Molding Process
A90-094 Ribosome System for Synthesis of New Polymers for Material Applications
A90-095 Nonplastic Substitute For The Plastic Milk Bladder
A90-096 Tentage System Thermal Signature Reduction

TANK-AUTOMOTIVE COMMAND

A91-097 Structures for Future Light Ground Combat Vehicles
A91-098 Structure Generated Noise Modeling Using Finite Element Analysis (FEA) Techniques
A91-099 Unmanned Ground Vehicle Mobility
A91-100 High Temperature Military Diesel Tribology Systems
A91-101 Exhaust Generated Noise Modeling
A91-102 Unmanned Ground Vehicle Subsystem Technology
A91-103 Unmanned Ground Vehicle Power and Cooling Subsystems
A91-104 High Temperature Military Diesel Engine Components
A91-105 Advanced Multi-Channel Digital Data Acquisition and Storage System
A91-106 Modular Armor Attachment Concepts
A91-107 Variable Emissivity Material(s)
A91-108 Fundamental Natural Language Components

U.S. ARMY TEST AND EVALUATION COMMAND

A91-109 Aeriel Cable Inspection Trolley
A91-110 Real-Time Trajectory Estimation Combining External/Internal Telemetry Measurements
A91-111 Real-Time Sensor Data Fusion
A91-112 Line of Sight Verification
A91-113 Inference Engine Test Methodology
A91-114 Knowledge Base Validation
A91-115 Unmanned Ground Vehicle (UGV) Indoor Tracking System
A91-116 Digital Enhancement and Video Storage of Real-Time Flash X-Rays

BALLISTICS RESEARCH LABORATORY
A91-117 Laser Ordnance Ignition Systems
A91-118 Investigation of Bulk Loaded Liquid Propellant Gun Concepts
A91-119 Down Barrel Propellant Injection
A91-120 Inert Boundaries for Controlling the Interior Ballistics of Bulk Loaded Liquid Propellant Guns
A91-121 Acoustic Liner for Dampening Pressure Oscillations in Regenerative Liquid Propellant Guns
A91-122 Diagnostic Probe

ARMY RESEARCH OFFICE
A91-123 Synthesis, Processing and Function of Complex Macromolecules in Biological Systems
A91-124 Remote Sensing of the Atmospheric Boundary Layer
A91-125 High Temperature Smart Sensors and Actuators
A91-126 Beam Processing of Materials
A91-127 Non-Destructive Evaluation Technology
A91-128 Optical Techniques for the Control and Data Processing of Microwave and Millimeter Arrays
A91-129 Robust and Adaptive Control for Multivariable and Nonlinear Systems

ATMOSPHERIC SCIENCE LABORATORY
A91-130 Mesoscale Saltation of Sand-Sized Particles in Turbulent Environments
A91-131 Acoustic Scattering by a Vortex Model of Turbulence
A91-132 Water Vapor Effects Upon the Thermodynamic Function of S[illegible]te

ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY
A91-133 Room Temperature IR Detector Sensitive in the 8-12f Wavelength Region
A91-134 Passive Millimeter Wave Imaging
A91-135 Chip on Glass for Flat Panel Displays
A91-136 High Energy Density Dielectric Materials
A91-137 Arsine and/or Phosphine Substitutes for Organometallic Vapor Phase Epitaxy (OMVPE)
A91-138 SAW Fourier Transform Subsystem with Digital Correction
A91-139 Autostereoscopic Video Displays
A91-140 Flux Pump for Charging Superconductive Inductance Tpe Energy Storage Systems
A91-141 Modeling of Electron Cyclotron Resonance (ECR) Plasma Process for Etching of III-V Compound Materials
A91-142 Title: High Peak Power/High Performance Power Combiner
A91-143 Reduction of Dislocations in Quartz Crystals
A91-144 Microcircuit Three-Dimensional Packaging
A91-145 Rechargeable Lithium Battery with Solid Electrolyte
A91-146 High Frequency Optical External Modulator
A91-147 Low Cost Dual-Mode Sensor Technology

HUMAN ENGINEERING LABORATORY
A91-148 User Interface Management System Tools for Army Planning Applications
A91-149 Global Positioning System Fuze Oscillator Design

A91-150 Human Performance Issues in Automatic Target Recognition
A91-151 The Human Factor in Information Displays in Combat Helicopters of the Future

HARRY DIAMOND LABORATORIES
A91-152 Advanced Composite Solder for Microelectronics
A91-153 Microscale Fluidic Components for Acoustic, Robotic and Advanced Signal Processing Applications
A91-154 Pulse Forming Network (PFN) for Expendable RF Source
A91-155 Subnanosecond Turn-On, REP–Rated Opening Switch
A91-156 RF Diode Laser Modulator
A91-157 Unobtrusive Air Chemistry Diagnostics for Aurora
A91-158 Electron Beam and Plasma Diagnostics for Drift Tube-Enhanced Gamma Simulator
A91-159 Parameter Testing of Multi-Branched Shielded Cables
A91-160 Time Dependent Beam Density Techniques
A91-161 Automated Composite Material Inspection System
A91-162 Advanced Technology Applied To Hardness Maintenance/Hardness Surveillance

MATERIALS TECHNOLOGY LABORATORY
A91-163 "Smart" Nondestructive Evaluation Sensor Systems for In-Process Control and In-Situ Monitoring
A91-164 Intelligent Database Management System
A91-165 Digital Image Monitoring of Fracture Processes
A91-166 Dry In-line Thermoplastic Matrix Impregnation
A91-167 Smart Environmental Sensors for Monitoring Prepreg Durability
A91-168 2-D Non-contacting Strain Measurement Device
A91-169 Field Portable Non-Contact NDE System for Composites
A91-170 Development of a Tungsten Heavy Alloy that Fails by an Adiabatic Shear Mechanism
A91-171 Strain Measuring Device for High Strain Rate and High Heating Rate Testing
A91-172 Novel Surface Treatments for Improved Adhesive Bonds

VULNERABILITY ASSESSMENT LABORATORY
A91-173 Large Duty Cycle Pulsed Semiconductor Diode Lasers

AVIATION SYSTEMS COMMAND
A91-174 Design Methodology of Low Susceptible Rotor Blades
A91-175 Advanced Computational Fluid Dynamics Methods for Elastic Helicopter Blades
A91-176 Acoustic Array Technique for Wind Tunnel Applications
A91-177 High Temperature, Abradable Coatings for Turbine Engine Compressors
A91-178 Advanced Fabrication of Powder Metallurgy (PM) Components
A91-179 High Performance Braided Structures Investigation
A91-180 Integrating Artificial Intelligence into the Aviation Simulation Network
A91-181 High Strength Thermoplastic Materials for Aircraft Components
A91-182 Directed Energy Damage Assessment and Repair
A91-183 Composite Material Treatments to Improve Abrasion Resistance
A91-184 Full Authority Automatic Flight Control For Adverse Combat Situations
A91-185 Covert Terrain/Obstacle Avoidance System for Helicopters
A91-186 Electrostatic Fuel Injector
A91-187 Electrically Conductive Composite Material Repair Techniques
A91-188 Real Time Associate System Technology
A91-189 Directed Energy Technology for Helicopters (DETH)
A91-190 High Temperature, High Speed Brush Seals

A91-191 Compact, Light-Weight Heat Exchanger
A91-192 Electrostatic Enhancement of Fine Particle Removal in Axial Inlet Particle Separators (IPS)
A91-193 Innovative Turbine Cooling Concept
A91-194 CASE Tools Support for Common Avionics Module Development
A91-195 Engine/Rotor/Auxiliary Thrust/Stability Integration System

CONSTRUCTION ENGINEERNG RESEARCH LABORATORY
A91-196 Active Control of Building StructuresUsing Shape Memory Alloys
A91-197 Neural Networks for Predictive Heating Ventilation Air Conditioning (HVAC) Controls
A91-198 Environmental Knowledge-Base Model for Facilities Design and Construction
A91-199 Geo-based Environmental Audit Support System

ENGINEER TOPOGRAPHIC LABORATORIES
A91-200 Capability to Assess/Quantify Improvements in Operational Performance Versus a Change in Data Base Characteristics
A91-201 Three Dimensional Modelling Station
A91-202 Landform Identification from Elevation Data Using Neural Nets
A91-203 Development of Formatting Utilities for Project 2851 Standard Simulator Database (SSDB) Output
A91-204 Text Identification, Extraction, and Manipulation Using Raster Map Images
A91-205 Urban Feature Digital Data Base

WATERWAYS EXPERIMENT STATION
A91-206 Generic Mixed Mode Integrated Circuit for Data Conditioning
ARMY RESEARCH INSTITUTE
A91-207 Reserve Force Structure Planning Model
A91-208 Sampling Combat Conditions for Simulation Fidelity
A91-209 Enhancing Soldier Performance Capabilities
A91-210 Automated Hover Trainer Expert System

US ARMY MEDICAL RESEARCH AND DEVELOPMENTAL COMMAND
A91-211 Environmental Health Monitoring Equipment - Ambient Temperature Sensor Suite
A91-212 Real-Time, Light Weight, X-Ray Imager
A91-213 A Temporary Dental Restorative Material for Military Field Use
A91-214 Development of Biodegradable Polymeric Delivery Systems for Bone-Inductive Proteins and Growth Factors
A91-215 Development of Diagnostic Probes for the Detection and Surveillance of Drug Resistant Parasitic Infections
A91-216 The Molecular Biology of the Mechanisms of Antiparasite Drug Action and Resistance
A91-217 Development of a Small Animal Infection/Protection Model for Dengue-3 Virus
A91-218 Production of Polyclonal Antibodies in Rabbits
A91-219 Development of a Cold Sterilant for Field Medical Use
A91-220 Development of Field Portable Methods for Amplification of Gene Probes for Use in Water Quality Analyses
A91-221 Preclinical Testing of Viral Vaccines
A91-222 Integration of Instrumentation for Measuring Vital Signs
A91-223 Vesicating or Blister Agents
A91-224 Pulmonary Agents
A91-225 Blood Agents
A91-226 Neurotoxins
A91-227 Medical Countermeasures Against "Toxic Agents of Biological Origin"
A91-228 Monoclonal Antibodies Against Biological Toxins

A91-229 Cellular Immune Response to Diseases of Military Importance
A91-230 Medicinal Chemistry - Synthesis of Potential Drugs Effective Against Toxic Agents of Biological Origin
A91-231 Detection and Diagnosis for Toxin Exposure

STRATEGIC DEFENSE COMMAND
A91-232 Optical/Ladar Tracking Systems for Kwajalein Atoll (KA) Application
A91-233 Impact Detection System for Kwajalein Atoll (KA) Application
A91-234 Search and Recovery of Reentry Vehicles at Kwajalein Atoll (KA)
A91-235 Tracking Radar Advanced Signal Processing and Computing for Kwajalein Atoll (KA) Application
A91-236 Range Safety Radar Processing and Computing for Kwajalein Atoll (KA) Application
A91-237 Debris Scattering Prediction for Kwajalein Atoll (KA) Application
A91-238 Biologically Motivated Nonlinear Dynamics for Smart Weapons
A91-239 Pulsed Carbon Dioxide Laser Propagation Analysis Capability
A91-240 Glint Return Tracking Capability for Far IR Pulsed Lasers
A91-241 High Energy Laser Target Plane Beam Diagnostic Instrumentation (BDI) Development
A91-242 Photonics and Optical Computing Research
A91-243 Microelectronics and Materials Research
A91-244 Advanced Signal/Data Processing Research
A91-245 Voice/Data Multiplexer for Communications
A91-246 Light Weight/High Power Radio Frequency Amplifiers for Communications
A91-247 Computer Architectures and Algorithms

PROJECT MANAGER FOR TRAINING DEVICES
A91-248 Advances in Training Performance Assessment for Force-on-Force Training Exercises
A91-249 Advances in Casualty Assessment for Force-on-Force Training Engagement
A91-250 Adverse Physical Factors Related to Simulators
A91-251 Manpower and Personnel Integration (MANPRINT) Assessment Issues
A91-252 Weapons Training Instrumentation
A91-253 Indirect Fire Weapon Simulation
A91-254 Simulator Networking
A91-255 Analytical Augmentation of Player Units in a Distributed Simulation Environment

U.S. ARMY

FY1991 TOPIC DESCRIPTIONS

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

A91-031 TITLE: Fire Control Battle Management and Decision Support System Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate advanced expert system decision aids for armor and/or artillery applications.

DESCRIPTION: The feasibility of developing high performance expert system decision aids for armor and artillery system applications has been demonstrated recently based on laboratory prototype tests. Further technology development is required, however, to address specific algorithmic issues associated with real time planning/replanning, sensor/information fusion, terrain analysis, as well as issues of knowledge engineering, man/machine interface, rapid prototyping and simulation environments for evaluating decision aids. Expert system decision aids which address one or more of the following requirements are of specific interest: (a) Identification Friend or Foe (IFF), (b) Fire Control (acquisition/tracking), (c) tactical planning/order preparation, (d) tactical situation assessment, (e) status/reports, (f) self defense of weapon platform, (g) sustainment, (h) command and control, (i) fire direction, (j) communications, (k) reconnaissance, selection and occupation of position and (l) embedded training.

Phase I: Develop methodology for design and implementation of distributed expert system decision aids for artillery and/or armor applications. Formulate and define conceptual designs for specific expert system modules including hardware implementation and software prototyping environment. Develop detailed functional specifications.

Phase II: Develop a full-up laboratory prototype decision support system with appropriate displays, simulation driven development environment and run-time environment. Optimize hardware/software, algorithm and interface design based on laboratory test results and provide complete documentation of hardware/software, analysis and test results.

A91-032 TITLE: Advanced Adaptive Weapon Control Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate low cost high performance digital servo control technology for precision fire-on-the-move applications including armor, air defense and aircraft system applications.

DESCRIPTION: Recently progress has been made in demonstrating major accuracy improvements for both aircraft and combat vehicle weapon systems using advanced digital control design techniques and Linear Quadratic Gaussian/Loop Transfer Recovery design approaches. Further improvements in gun accuracy are anticipated through the development of improved robust nonlinear and adaptive control laws and control laws that exploit recent advances in H infinity control system design methodology. High speed, low cost micro computer technology now permits these techniques to be implemented in high bandwidth digital servo loops required for precision gun stabilization. This project will address the

broad spectrum of issues associated with the development of design tools and methodology, modeling, simulation and real time hardware/software implementation.

Phase I: Develop methodology for design and implementation of high performance robust adaptive and nonlinear control laws for precision weapon stabilization and tracking. Formulate specific control laws for nominal two input, multi output nonlinear plant with friction, backlash, resonant modes, high impulse periodic disturbances nonlinear compliance and sensor noise. Determine performance and robustness characteristic with respects to structural and unstructured plant perturbations and provide analysis of hardware/software implementation requirements.

Phase II: Develop a fully integrated design, test and prototyping environment for advanced nonlinear and adaptive multivariable control systems. Provide a real time programmable digital control module with on-line data analysis capability and I/O capability necessary for laboratory test bed evaluation. Optimize module hardware/software and algorithm design based on test data and provide complete documentation of algorithms and hardware/software architecture.

A91-033 TITLE: Intelligent Sensor Based Robotic Control Systems Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop a generic multi-adaptive robotic control module and development environment for mobile manipulator systems for ammunition handling, resupply and logistics applications.

DESCRIPTION: Significant progress has been made recently in developing advanced sensor based servo control systems for high performance robotic manipulators. Specifically, a high speed 386 based multi-processor robotic control module and software development environment was developed which permits a broad range of adaptive and compliant motion control strategies to be implemented for arbitrary manipulator configurations. Extensions of this technology are required, however, to deal with fundamental problems of mobility and base motion effects, flexibility task level control, multi- sensor integration, dual arm coordination associated with fusing ammunition in a moving resupply vehicle, and depalletizing and transferring ammunition to and from a resupply vehicle and loading ammunition in a moving platform environment. Technical issues of interest include robust and adaptive controls, compliant motion control, visual servo control, voice natural language interface for control, dual arm control strategies, world modeling design environment, real time, knowledge based task level control and control from moving base including path planning, navigation and obstacle detection/avoidance.

Phase I: Develop methodology and algorithmic approaches to intelligent sensor based robotic control systems for applications to materiel handling and loading. Perform preliminary modeling and simulation studies to determine performance/robustness characteristics of the control laws and algorithms, real time processing requirements and sensor requirements. Provide analysis for evaluating control laws and provide control processor design and system hardware specifications.

Phase II: Develop controller hardware/software and development environment for interface with laboratory test bed manipulator systems. Develop test scenarios and scaled down mock-ups to demonstrate controller performance capabilities. Provide fully integrated prototype module with documentation source code and development environment and evaluate in laboratory tests.

A91-034 TITLE: Passive Sensor Self-Interference Cancellation

CATEGORY: Exploratory Development

OBJECTIVE: Develop practical and effective local noise cancellation/reduction capability to substantially reduce degradation of passive acoustic sensor performance.

DESCRIPTION: The ability of an acoustic sensor to detect, classify, identify, and locate targets is

degraded by own-platform noise and local interference. Elementary Automatic Noise Cancellation (ANC) techniques such as the classic Widrow algorithm, do not offer sufficient acoustic noise cancellation when the vehicle/platform is stationary-operating. Noise cancellation becomes very difficult when operating "on-the-move". Initial research should address innovative approaches for effective and practical ANC when the weapon platform is in operation and the vehicle is stationary with the engine on. Examples of possible approaches are multiple reference sensors, and adaptive spatial null-stering. This research should also address development of highly robust acoustic sensor algorithms which resist performance degradation in noise environments. Army mission areas directly supported by this research include Air-Defense (FAADS), Close Combat (Anti-Armor), and Fire Support (Artillery location, AFAS).

Phase I: Assess required noise cancellation/reduction needed to achieve effective performance of acoustic sensor systems on weapons platforms (Noise degrades the sensor's target detection range, classification/ID, location & tracking performance). Measure the noise fields of one or more candidate Army weapons platforms. Develop noise cancellation/reduction techniques and signal processing algorithms to achieve this required level of performance. Investigate feasibility of cancelling/reducing "on-the-move" vehicle noise.

Phase II: Construct experimental noise cancellation and/or noise reduction hardware utilizing the techniques developed in Phase I. Perform laboratory and field tests to measure effectiveness of the noise reduction/cancellation techniques and the resulting performance improvements of the passive sensor system when operated on a Army weapons platform.

A91-035 TITLE: High Performance Propelling Charges

CATEGORY: Exploratory Development

OBJECTIVE: This high energy density propellling charges will be developed for effective application in the igniter system, and provide excellent reproducibility and may enhance the firing capability of new weapons.

DESCRIPTION: The trend in ballistic system design is toward use of those propellants which produce a high energy per unit volume. Consequently, there is considerable interest in use of consolidated, bonded and unified charges of various fluid propellants (liquid, gel, emulsion and slurry propellants) and new solid propellants. High energy propellants are constantly sought for existing traditional weapons systems and for liquid propellants (LP) gun systems including regenerative and bulk loaded systems. In addition, a new technology is evolving, electrothermal chemical (ETC) propulsion, which demands high energy density propelling charges for effective application in viable systems. The propellants developed along with their resulting propelling charges must fulfill requirements which are system dependent and sometimes unique. For example, a traditional solid propellant gun system may require a propellant which has a high energy density coupled with low flame temperature while a liquid propellant gun or an ETC gun might have a different set of requirements. This increased energy density, however, can result in instabilities which run counter to the need for reproducibility of performance at accepted levels. Based on experimental evidence, much can be done to alleviate these problems. For example, careful tailoring of the ignition system (e.g. pyrotechnic, electric, laser, plasma, etc) can do much toward achieving an effective ballistic system. New high energy density propellants and high performance propelling charges need to be developed. In addition, analytical and experimental efforts in the fundamental study of ignition and combustion characteristics of the newly developed high energy density propellants must be carried out.

Phase I: Develop new families of high energy density propellants which will be candidates for high performance propelling charges. The propellants formulations may consist of novel oxidizers and/or fuels or may consist of novel formulations of readily available oxidizer and fuel candidates. Fabricate small quantities of propellant for feasibility assessment.

Phase II: Develop igniter systems for candidate high energy density propellant. These igniter

systems should produce efficient and effective ignition and reproducible combustion of the candidate propellants and reproducible combustion.

A91-036 TITLE: Prognostic and Diagnostic Restructurable Controller Module

CATEGORY: Exploratory Development

OBJECTIVE: The objective of the R&D is to develop and demonstrate a device/process controller with the capability to reason about its mission, environment, and performance, while the environment undergoes structural changes. The controller must be capable of; (1) controlling mission events in a dynamic environment, (2) monitoring & diagnosing current behavior, and (3) prognosticating about possible future performance faults as well as maintanence needs. Hence, end objective is to develop a controller capable of interfacing/controlling the next generation Howitzer.

DESCRIPTION: In recent years, researchers have made significant progress in specific areas of Artificial Intelligence (AI), e.g, Expert Systems, Qualitative Reasoning, Machine Learning, Automatic Fault Diagnosis, and other areas related to the Intelligent Control of electro-mechanical systems (continuous or intermittent). If this technical areas can be integrated with appropriate environmental sensors and applied to control physical systems on the Advance self-propelled howitzer, a major step towards AFAS goals for personnel reduction, as well as improved reliability, availability and maintainability will be achieved. However, to achieve the goals, further R&D in reasoning about three core domains of the intelligent controller, i.e., mission events, static/dynamic environment, and performance evaluation, is needed.

MISSION EVENTS: The mechanical events, for example, that a device must execute to complete its mission might be described as a push, pull or turn an item. Reasoning about those events requires knowledge about the system's kinematic and dynamic behavior. R&D is needed to advance the method of reasoning about kinematics and dynamics of controlled devices/processes as their operational characteristics undergo structural change. For example, continuous use of the system develops wear on some mechanical elements which in turn, causes an increase in "back lash" that results in a qualitative change in operating behavior. Thus, the change might cause the device to move improperly and cause a malfunction.

The system's performance may be altered significantly as the environment in which it operates changes. For example, an automatic device may perform well when the self-propelled vehicle is at rest and poorly when the platform is in motion. Thus, the utilization of machine learning to monitor and update the device's model and employ qualitative reasoning about possible future performances faults should be investigated.

Qualitative reasoning about the system's performance characteristics depends not only on kinematic/dynamic behavior of mechanisms but the integrity of signal inputs to the controller that monitors the behavior. Thus if a sensor is faulty, the data it generates may lead to incorrect conclusions. To avoid this type of flaw, the intelligent controller must reason about its performance. Thus, it is important that the research address a range of issues related to data/sensors fusion and fault diagnosis.

Phase I: The Phase I will (1) furnish greater detail to support a conceptual approach for sensor-based monitoring of the system's principal characteristics that reflect normal/abnormal operating behavior, (2) develop and/or furnish basic algorithms necessary to accept sensor input, reason about performance, detect and diagnose abnormal execution, predict possible faults, generate preventive maintenance request, and exert appropriate control while characteristics are changing. The conceptual approach should be applied to a typical artillery system or sub-system, i.e, 155mm self- propelled delivery platform, fire control, ammunition loading, zoning or similar functional entity.

Phase II: The Phase II program will design, develop, integrate and demonstrate a real time adaptive/prognostic/diagnostic controller applied to the chosen sub-system. An integral part of the R&D would include a complete theoretical analysis as well as modeling (mechanical and/or computer) and

simulation studies to asses primary and secondary behavior characteristics and their influence on performance.

A91-037 TITLE: Device for Measuring the Decomposition Shear Rate of Highly Solids Filled Energetic Materials

CATEGORY: Engineering Development

OBJECTIVE: Develop and demonstrate a device to quantitatively determine the shear rate decomposition conditions for energetic materials and compositions.

DESCRIPTION: The Department of Defense (DoD) and private sector chemical propulsion firms have been investigating the use of continuous twin screw mixing and extrusion machines to manufacture propellant and explosives. This processing approach offers advantages in lower production costs, reduced personnel exposure, smaller quantities of in process material, reduced capital equipment costs, and improved product uniformity. Initial pilot scale work has been very promising. Also, academic studies are being conducted to develop rheological data and to establish models with which to design and scale up from the pilot plant work. Indications from these studies are that the shear rates obtained in these machines are much higher than those experienced in batch mixers. At these very high shear rates, energetic compounds may decompose leading to an explosion or a degradation of the materials being processed. There is no known procedure to test for the decomposition shear rate of an energetic material. This project is to develop and demonstrate a device, suitable for use in a laboratory to reliably measure the shear rate at which decomposition occurs.

Phase I: A design for a laboratory device to measure the effects of shear rate on energetic materials will be prepared. A hazards analysis will be prepared in conjunction with the design.

Phase II: The device will then be built and tested with nonenergetic materials which have demonstrated instability under shear, such as polyvinylchloride. The device will then be shipped to ARDEC and installed in the ARDEC Rheology Laboratory. Training will be provided ARDEC operators in the use of the device.

A91-038 TITLE: Moisture-Resistant Material for Ammunition Fiber Containers

CATEGORY: Exploratory Development

OBJECTIVE: Develop a cost-effective material for the spirally wound fiber containers that will neither absorb nor transmit moisture.

DESCRIPTION: Mortar cartridges are packed in fiber containers manufactured in accordance with MIL-C-2439. Some containers are overpacked in sealed metal containers (60mm and 120mm). Other cartridges are packed in wood boxes (81mm and 4.2 inch). Fiber containers are made up of several layers. The outer layers consist of asphalt impregnated paper and aluminum foil which provide a moisture barrier. The inner layers are made from container board. After manufacture, the containers are often stored for a long period of time in an uncontrolled warehouse environment prior to packout of ammunition. This long term storage period allows the fiber container to pick up moisture. There are currently no check of the moisture content of the fiber container at pack out. This situation allows for moisture to be sealed inside the container next to the ammunition. Moisture can cause corrosion of the ammunition and degradation of the performance of the fuze and propellant.

Phase I: The contractor will devise a container system that will be less hygroscopic than the current system which uses ammunition container board. It is highly desirable that current manufacturing techniques used for manufacturing fiber containers be maintained although it is not mandatory. Every

effort should be made to simply substitute new materials. At the end of Phase I the contractor shall deliver: a. A report, that includes test data, which recommends a minimum of three alternate configurations. b. Ten samples each of wound tubes or containers manufactured from each alternative.

Phase II: The contractor shall develop complete containers of alternate configurations and subject these alternates to a complete sequence of temperature - humidity - rain - soak tests. The contractor shall recommend an optimal container configuration for manufacture. The contractor shall deliver 100 containers of an agreed upon configuration to the US Government for test.

A91-039 TITLE: Improved Pyrotechnic Compositions for Future High Performance Ammunition

CATEGORY: Exploratory Development

OBJECTIVE: Develop new pyrotechnic compositions, having generic applications, which will provide enhanced brightness and improved range capability over current state of the art pyrotechnic/tracer compositions. Upon completion of Phase II, Product Improvement or Engineering Study Proposals would be submitted for improvement/enhancement of current tracer projectiles for Phase III funding.

DESCRIPTION: Present technology for pyrotechnic composition was developed in the 1940's and 1950's. No new advances in pyrotechnic technology have been made to keep pace with the advanced fighting systems that have been or will be developed and fielded in the future. The newest small arms system, the 5.56mm Squad Automatic Weapon (SAW), with its extremely high spin rate (>300,000 rpm) is required to provide a 900 meter day and night trace capability when firing the M856 tracer cartridge. The users have in the past expressed dissatisfaction with the daylight luminosity levels of the M856, desiring visibility closer to that achievable with the larger caliber 7.62mm M62; however, current tracer fuel/oxidizer compositions fail to provide the desired characteristics of long range and high day luminosity. Basic exploratory development of new tracer chemistry for small arms applications is needed. New systems which may be fielded in the future will consist of subcaliber projectiles with extremely small tracer orifice openings and volumes. In addition, they will have shorter times of flight due to their high velocities. These projectiles which will fly farther will require pyrotechnic compositions that burn longer and brighter than is currently possible within the state of the art.

Phase I: Initiate a search for new approaches to tracer technology. This will consist of identifying and evaluating new technologies for light production which could be applied to the development of pyrotechnic compositions. Candidate compositions or technologies will be formulated and loaded into simulated projectiles and evaluated in a test fixture at different spin rates for brightness and burn rate. From the results obtained several candidate compositions will be chosen for evaluation in Phase II. In addition, for each new composition, a process for formulation and blending would be provided.

Phase II: Candidate compositions from Phase one will be charged into representative projectiles of several different calibers. The projectiles would then be loaded into cartridges and fired from a weapon. The results of these firings would be analyzed in order to assess trace quality, duration and luminosity; and recommendations made as to their suitability for use as a tracer composition.

A91-040 TITLE: X-ray Inspection of Munition Items

CATEGORY: Exploratory Development

OBJECTIVE: Develop sensors for converting x-rays directly to a digitized image with improved efficiency over that of current methods.

DESCRIPTION: General - There exists a trend within the Army to automate x-ray inspection of munition items. Such inspection systems need to be able to efficiently convert high energy x-rays in real time to a digital format with high spatial (2-dimensional image) and high density resolution. For such energy ranges, the current technology generally involves the use of a scintillator followed by an image intensifier and finally a camera with digital output. Such a system suffers from degradation over time of the scintillator, requires removing the camera from the x-ray beam, and generally results in a low signal-to-noise ratio. This solicitation is for the development of high efficiency, high resolution sensors for converting x-rays, whose energy range is from 300 KV to 1 MV, into a digital output with improved efficiency over that of current methods. The proposal should detail a specific potential improved method.

Phase I: Investigate and assess the feasibility and level of improvement of the specific proposed method.

Phase II: Design and fabricate a prototype of the method. Demonstrate the capability of the prototype on munition items.

A91-041 TITLE: Neural Network Based Speech Identification/Transcription Module for Embedded Crew Station Applications

CATEGORY: Exploratory Development

OBJECTIVE: Develop a neural network based voice recognition system that can identify and extract the speech of a single person from a signal containing other speakers and random noises, and then produce a transcription of the recognized words for embedded crew station (howitzer) applications.

DESCRIPTION: Progress is slowly being made in the area of speech recognition, but as yet no system can work well in a noisy crew station environment. This problem is compounded when the background noise is random or contains other voices. A voice recognition system capable of locking on to a speaker's voice commands would enable the howitzer combat crew to function more effectively and responsively and without a special microphone or headset which is currently required to acoustically separate the speaker from the environment. Artificial neural networks are currently being examined to solve this problem and appear to hold the greatest potential, but considerable amounts of conventional signal preprocessing may still be required. Technical issues of interest include noise reduction, speaker identification, language identification and language transcription.

Phase I: Develop methodology and approaches for enabling a neural network to learn and identify a designated operators command in a crew station environment with other voices and random background noises. Determine requirements for any signal preprocessing needed by the net, and provide system design specifications.

Phase II: Develop neural network based voice recognition hardware/software and development environment for interface with laboratory test bed environment. Develop test scenarios to demonstrate the recognition system's ability to learn and identify a designated operators voice in a crew station environment and transcribe what is said disregarding any random noises and other voices present in the signal. Provide fully integrated prototype module with documentation, source code and development environment and evaluate in laboratory test.

A91-042 TITLE: Miniaturization of Accelerometers for Advanced Cannon Caliber Fuzing

CATEGORY: Exploratory Development

OBJECTIVE: Develop a small, low cost ccelerometer and correction circuit for cannon caliber (20-40mm) fuzing.

DESCRIPTION: The future of cannon caliber munitions require improved lethality which may be achieved by functioning the projectile over the target prior to impact. This will then entail the need for more complex fuzing. In order for the fuze to burst a small projectile with a limited lethal radius accurately over the target, it must correct for errors in the ballistic flight. Several programs currently underway would benefit from the development of such a sensor. Examples are the Advanced Crew-Served Weapon System, Combat Vehicle Armament Technology (COMVAT) and the Future Individual Grenade Launcher. One munition concept for such weapon systems includes the use of a rocket motor. The combination of error in the initial launch of the projectile with the error of the rocket motor burn would make it extremely difficult to engage a target within the lethal radius of the projectile.

Phase I: Develop methodology for the integration of an accelerometer into an electronic timer based on established general flight characteristics of the developmental ammunition. Demonstrate the methodology at bench level and provide a plan for miniaturization and future testing.

Phase II: Construct 10 miniaturized circuits for telemetry testing on existing ammunition with rocket motors to demonstrate that the technology will work.

BELVOIR RESEARCH DEVELOPMENT AND ENGINEERING CENTER

A91-043 TITLE: Mine Detection - Handheld and Vehicular

CATEGORY: Research/Exploratory Development

OBJECTIVE: To analytically or experimentally demonstrate the feasibility of mine detection concepts.

DESCRIPTION: The Army currently has only a hand held metallic mine detector in its inventory. There is a critical need for a capability to detect nonmetallic as well as metallic mines. The need is for both hand held and vehicular mounted close in detection of mines.

In all military conflicts since WWI, mine warfare has played a large role. Troop and equipment losses due to mines have been a significant portion of the total losses in WWII, Korea, and Vietnam. The Army's inability to detect mines has been a major factor in this problem and an improvement in this capability is a substantial need of the modern Army.

The existing capability is limited to the detection of metallic mines with a handheld device. Army needs include handheld detectors and vehicular mounted detectors which can detect both metallic and nonmetallic mines. The Army is interested in investigating concepts which have the potential for providing this capability. There are no limits or constraints on specific technologies which may be proposed. The objectives of proposed research should relate directly to the detection of mines and exploration of the technical feasibility of the proposed detection concept rather than improved platforms, processing or other auxiliary functions.

Phase I: An analytical demonstration of the concept feasibility is required. A description of an experimental approach that would verify the analytical results is required.

Phase II. Experimental verification preferably in a natural environment is required.

A91-044 TITLE: IR Transparent Binders with CARC Capabilities

CATEGORY: Exploratory Development

OBJECTIVE: To develop a new class of paint binders which are transparent in the thermal infrared wavebands (3-5 and 8-12 microns) and meet the requirements for chemical agent resistant coatings.

DESCRIPTION: The development of low emissivity coatings in the thermal infrared wavebands are being pursued by the Army to help reduce detectability of military assets on the battlefield by thermal sensors. In order for low emissivity coatings to be effective, binders must be developed which do not negate the pigment's effects and must meet the Army's CARC requirements. The lack of a suitable IR transparent CARC binder is the biggest technical deficiency to fielding a thermal suppressive paint of the Army.

Phase I: In Phase I the offerer would survey the literature for previous developmental work on thermal IR transparent binders and compile a list of required physical and electro-optical properties to produce an acceptable binder. A strategy to develop components for at least 3 binder systems with acceptable electo-optic and CARC properties would be established. Based on the required properties, the most promising material approach would be selected and development efforts would be initiated.

Phase II: Based on the results of the initial development strategy, at least two other systems would be recommended and development of these binder systems would be pursued. Prior to conclusion of the effort, the best binder would be selected and coatings with several different colors and emissivities would be demonstrated.

A91-045 TITLE: Active Noise and Vibration Control for Auxiliary Power Units

CATEGORY: Exploratory Development

OBJECTIVE: To demonstrate affordable noise and vibration control in compact auxiliary power generating equipment.

DESCRIPTION: The Army is moving toward integration of engine driven electric generators and air conditioners into shelters and vehicles. These auxiliary power units (APUs) enhance mobility and reduce the time and labor required to set up systems when compared to the present practice of using separate engine driven electric generators connected by cables. However, the use of on board APUs increases emphasis on minimum weight and size while making very low noise and vibration critical for human factors and non-detectability on the battlefield.

At present we use passive shock mounts, mufflers, baffles and acoustic absorbers to achieve noise less than 85 dB(A) at one meter outside shelters and 65 dB(A) inside. These are the maximum allowable noise levels. We desire at least a 10 dB(A) reduction without significant additional space and weight.

It appears that close coupled "active" noise cancellation or actively tuned resonators may prove to be beneficial in reducing the exhaust noise and "active" engine mounts could reduce the mechanical transmission of noise through the mounting and enclosure system. We are seeking affordable technological solutions for APUs in the 20 to 60 hp range that will minimize noise and vibration with minimal additional space required.

Phase I: Develop designs for both low and high end horsepower spectrum and develop a program plan for demonstrating these designs in Phase II.

Phase II: Build and test 10 and 30 kilowat generator sets using the Phase I design.

COMMUNICATIONS ELECTRONICS COMMAND

A91-046 TITLE: Real Time Monitoring of MBE Mercury Cadmium Telluride Growth

CATEGORY: Exploratory Development

OBJECTIVE: Develop In-Situ optical characterization technique for monitoring and interactively modifying the growth of mercury cadmium telluride (MCT) by molecular beam epitaxy (MBE).

DESCRIPTION: MBE growth of MCT offers the opportunity to determine and alter the dynamic evolution of the growth surface. Real time non-invasive optical techniques are required to determine the surface Hg concentration in MCT. The optical technique should allow computer feedback to the growth process so growth conditions can be interactively changed.

Phase I: Develop optical or other remote techniques to determine Hg surface concentration of MCT. These techniques must be compatible with (1) ultra high vacuum environment; (2) substrate temperatures between 150 degrees and 250 degrees c; (3) provide feedback signal to control the growth system in real time.

Phase II: The best optical techniques will be optimized and tested. Testing will be accomplished by constructing optical technique modules delivered to C2NVEO, coupling to the new C2NVEO MBE system, demonstrating Hg surface concentration determination and real time interactive control of the MBE system.

A91-047 TITLE: 77K Thermoelectric Cooler

CATEGORY: Exploratory Development

OBJECTIVE: Develop new high performance thermoelectric material for building a 77K thermoelectric cooler.

DESCRIPTION: Present cryogenic coolers for 77K operation are not reliable and generate noise and vibration. Strategic IR sensors require long life in space and tactical IR sensors require low acoustic noise and vibration. Thermoelectric cooling is solid state with no moving parts and would represent a breakthrough for electro-optic sensors.

Phase I: Using present day modeling programs, generate a list of potential new thermoelectric materials that have the required properties for obtaining 77K operation with a 1% coefficient at performance.

Phase II: Design several thermoelectric coolers for 77K operation and evaluate all performance parameters.

A91-048 TITLE: Adaptive Recognizers for Signal Processing

CATEGORY: Advanced Development

OBJECTIVE: Develop recognition algorithms and implement them in a neural computer architecture. The algorithms would be initially trained to the signal environment but would then adapt to changing battlefield conditions and operational modes.

DESCRIPTION: Typical communication signal recognizers use variations of pattern recognition techniques to identify unique emitters. They require priori knowledge to work well and are not readily adaptable to changing battlefield conditions. The goal of this effort is to develop algorithms and processors to implement these algorithms that use artificial intelligence/expert systems (AI/ES) to adapt to changing conditions so that the recognizers can continue to catalog the signal environment without

being retrained.

Phase I: Develop a technique and algorithm(s) using AI/ES that allow a recognizer to "follow" the signal as it changes through normal aging of components or mode changes.

Phase II: Develop a neural network implementation approach to implement the solution developed under Phase I.

A91-049 TITLE: Field Specifiable/Modifiable Message Parser

CATEGORY: Exploratory Development

OBJECTIVE: Develop a sophisticated software message parsing tool that allows a field user to generate a new message type specification or modify a message type specification. The message parser dynamically uses the specification to generate the code that parses the message. The parser should allow for the handling of corrupt and erroneous data in an orderly manner while allowing for maximum flexibility for variations of expected input to be processed. The parser should exist as a stand alone software service to be accessed by various application clients.

DESCRIPTION: Current fielded message parsers tend to be inflexible and rigid. Tactical army users desire a message parser capability with which they can not only modify existing message types in the field but also generate completely new message types to meet their mission needs. These messages are pseudo formatted and not free text. The resultant specification must include an entry/display form mechanism separate from the parser. Critical issues in this effort are the semantics of the high order message parser specification language, calling conventions, an object oriented service interface, data mapping mechanisms, service library requirements, and relationships between multiple message specifications. The desired produce is to be a stand alone module that can be incorporated into various systems.

Phase I: This phase should result in a proof of principal demonstration of the basic tool mechanisms implemented and functioning. The demonstration can utilize PC based systems, a DEC VAX with DecWindows, or a pure X-windows with MIT tool kit version to be compatible with the government facility. The design of the proof of principal should clearly reflect the extension of the tool to other systems, data sources, and windowing systems. A final Phase I report with documented software will be required.

Phase II: This phase shall take the Phase I result and produce a usable and extendable tool to be utilized by government system developers. The tool's functionality and features will be extended to accommodate the most common message data types. In addition to a final report a programmer's reference manual, software maintenance
manual and user's guide will be required.

A91-050 TITLE: Fusion Applications Environment

CATEGORY: Exploratory Development

OBJECTIVE: Develop a sophisticated software applications environment module that allows a field fusion analyst to select, specify and modify tactical intelligence data fusion applications processing paths.

DESCRIPTION: Current fielded tactical intelligence data fusion applications are static and monolithic in nature. The tactical intelligence data fusion environment is very dynamic and requires that specific applications be field modifiable to meet changing threats and mission requirements. Each application can be viewed as a specific processing path utilizing common utilities accomplishing a specific function.

Across the spectrum of fusion applications the variances of processing paths are mission dependent. These fusion applications utilize the same basic processes but vary the sequence of execution or select one function over another based upon the data. What is desired is a mechanism for the field analyst to specify, modify or create new processing paths for fusion processing. Individual functions will have been previously defined and encapsulated in the environment. The developer must define the requirements for this encapsulation and linking of modules. The ability to accomplish this should be done in a graphical form. The desired product is to be a stand alone module that can be integrated into a software services backplane.

Phase I: This phase should result in a proof of principal demonstration of the basic tool mechanisms implemented and functioning. The demonstration can utilize PC based systems, a DEC VAX with DecWindows, or a pure X-windows with MIT tool kit version to be compatible with the government facility. The design of the proof of principal should clearly reflect the extension of the tool to other systems, data sources, and windowing systems. A final Phase I report with documented software will be required.

Phase II: This phase shall take the Phase I result and produce a usable and extendable tool to be utilized by government system developers. The tool's functionality and features will be extended to accommodate the most common tactical intelligence data fusion requirements. In addition to a final report, a programmer's reference manual, software maintenance manual and user's guide will be required.

A91-051 TITLE: Wavelet Research for Electonics Support Measures

CATEGORY: Advanced Signal Processing and Computing

OBJECTIVE: To apply the relatively new theory of wavelets to: (1) reducing the computational complexity of high-resolution direction-finding, and (2) the problem detecting signals by edge detection.

DESCRIPTION: High-resolution direction-finding requires a significant number of matrix calculations, which are repeated for each frequency channel that an ESM system monitors. The typical tactical ESM system monitors 4,000 channels at minimum. Wavelet theory has been shown so reduce and simplify large matrix calculations, but has not been extended to the field of high-resolution direction-finding. A second characteristic of wavelets alolows a simplified representation of
edge information which may provide a significant enhancement in detecting pulseed emitters since primary features for detection are the pulse leading and trailing edges.

Phase I: Develop and apply the theory of wavelets to both high-resolution direction-finding and pulse edge detection. Testing the ideas developed in this phase will be accommodated with both real, collected data and simulated sources.

Phase II: To construct with commercial digital hardware a wavelet transform capability for real-time execution.

A91-052 TITLE: Modeling and Simulation of Small Satellite EHF Communications

CATEGORY: Exp[illegible]ratory Development

OBJECTIVE: Survey, identify, develop and prototype a computer modeling and simulation toolset to model and evaluate small satellite EHF communication architectures.

DESCRIPTION: There is strong interest to support and develop EHF communication architectures for use in the current and anticipated operation of small, low earth orbit satellites. Small, expendable satellite constellations are envisioned to provide tactical satellite communications to future "quick reaction" army field units, essentially providing "on-demand" communication via space. Present small

satellite initiatives center around UHF architectures. The inherent advantage of small antenna size, high data rate, low probability of intercept (LPI) and detection (LPD) and power efficiency of the EHF band makes transition to this band desirable. Trade-off studies could be completed and "what if" questions answered regarding competing architectures for small satellites by using work station or PC based modeling and simulation tools.

Phase I: Survey and identify all small satellite architectures applicable to the EHF bandwidth with appropriate consideration given to mode FDMA, TDMA, DAMA etc., data rate (up to and including video), error correction, jam resistance, LPI and LPD, and networking peculiar to non-geosynchronous EHF operation (e.g. handover from one satellite to another), ground segment requirements, link budget, and related factors must be considered. From this information, propose a PC or workstation based computer model that could simulate operation of the full range of communication schemes and architectures identified in the Phase I survey. The model should at least include simulation outputs such as eye diagrams, bit error rate (waterfall plots), link budgets and antenna coverage loci in each mode. The limitations and inadequacies of the model should also be identified at this time.

Phase II: Produce working prototype of the small satellite network/architecture simulation and modeling program proposed in Phase I. Demonstrate utility and correctness of the simulation model and environment against a series of benchmarks including networking a constellation of six low earth orbit satellites in a DAMA mode in a tactical (under 1000 miles) communication scenario.

A91-053 TITLE: Artificial Intelligence (AI)/Expert System in Microchip Applications

CATEGORY: Exploratory Development

OBJECTIVE: Develop an AI/Expert System shell which is microchip resident and provides an on-board system capability for performing functional data analysis and diagnostics/prognostics.

DESCRIPTION: Army systems are being developed with an increasing number of microelectronic components. Microchips will also be used for an increasing number of logistics applications, e.g., time-stress measurement, failure histories, elapsed time, etc. What is necessary is an on-board system AI/Expert System shell to extract various system and failure information/data from other on-board chips in order to perform on-board diagnostics and eventually prognostics. The AI/Expert System Shell shall be a microchip resident system and may be designed for distributed decision making.

Phase I: Conduct investigations, technical analyses, trade-offs and preliminary developmentinto microchip resident AI/Expert Systems considering software, standard Army bus interfaces, communications and design implementation.

Phase II: Design operational model to demonstrate AI/Expert System Shell functionality proposed in Phase I to accomplish objective. Also, document the design and software development tools and applications.

A91-054 TITLE: Voice Processing for Command and Control Applications

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate a universal and cost effective approach for voice recognition and synthesis in a tactical environment using microelectronics and advanced signal processing and computing techniques.

DESCRIPTION: Automated voice processing techniques can improve the effectivity of the soldier's task capabilities in a tactical environment. Operations in a mobile vehicle on the move can be achieved

using voice command and control technology that are superior to traditional hand manipulated devices. Areas of particular interest to be investigated include trade-off of algorithms, capabilities, and implementation schemes that support the Army Tactical Command and Control System (ATCCS) and Battlefield Functional Areas (BFA) demands.

Phase I: Phase I will address and demonstrate competing architectures using real BFA application software and ATCCS common hardware and software to address proof of concept.

Phase II: Phase II will culminate in a prototype electronic product design satisfying the demands, requirements, and conditions addressed during the previous phase. This phase will also provide production method scale up to meet commercial as well as DoD required production levels.

A91-055 TITLE: Acoustic Sensor Performance Effectiveness Estimation

CATEGORY: Exploratory Development

OBJECTIVE: Develop new techniques and ultimately a tool to simply and efficiently gauge, estimate, and predict the range performance of omnidirectional acoustic sensors deployed for tactical use. Display this information graphically alone and ultimately as a digital map overlay. Phase I would result in a methodology and design for the performance effectiveness estimator. Phase II would develop/fabricate the required hardware and implement the software for the estimator.

DESCRIPTION: All acoustic sensors performance are sensitive to atmospheric, meteorological and terrain variabilities. As acoustic sensors with various missions at tactically interesting frequencies enter the Army inventory, tools will be required to determine their estimated range performance at any given location based upon ambient conditions. This task requires a clear understanding of acoustics, acoustic propagation, and related technologies. Part of this task would involve developing lookup tables for propagation effects from appropriate propagation models and interpolating the data from the tables to provide propagation effects information. The merging of propagation effects information, data from portable meteorological equipment, type of terrain, time of day, season of year and other pertinent information should provide useful acoustic performance estimations for tactical decision makers.

Phase I: Define parameters required for estimating range performance. Develop a method of obtaining and merging appropriate acoustic parameters into a range effectiveness estimation tool. Design a hardware/software solution for implementation of this tool and its graphical interface.

Phase II: Implement, test and refine the hardware/software solution developed in Phase I. Provide a useful, comprehensive high resolution graphical display for field testing with acoustic sensor systems.

A91-056 TITLE: Monolithic Scanning Antennas

CATEGORY: Exploratory Development

OBJECTIVE: Develop new electronic scanning antenna techniques for microwave and millimeter wave frequencies. Materials would be of construction employing low observable design technology. Phase I would result in promising innovative design techniques, one of which would be carried over into the development/fabrication stage during Phase II.

DESCRIPTION: New fabrication concepts are needed to reduce size, weight, radar cross section, and significantly, cost, of microwave and millimeter wave electronic scanning antennas. This may be done through monolithic design. Intelligent combinations of the radiating aperture, the feed network, and the phasing scheme within a monolithic arrangement can lead to lower cost antennas, particularly at millimeter wavelengths. Reduced complexity is possible by reduction of the numbers of individual phase shifters that are normally associated with each radiating element. The objective of this SBIR is to

investigate concepts which would use presently available material technologies and select one of those concepts which will result in the fabrication of a practical monolithic antenna structure for Phase II.

Wide angle electronically scanned phased array antennas typically use one phase shifter per radiating element. This results in increased cost, primarily due to the cost of the phase shifter. Techniques are being developed to reduce the cost of scanning arrays by eliminating the individual electronic phase shifter via electromechanical feed schemes. A further advancement in this evolutionary development is to investigate an integral monolithic design for the entire array.

Phase I: Create the design concepts for incorporating the radiating aperture, the feed network, and the phasing scheme within a monolithic structure.

Phase II: Develop the selected concept into a practical model and demonstrate unidirectional electronic scan.

A91-057 TITLE: Concentrator for Extended Infrared Sources

CATEGORY: Exploratory Development

OBJECTIVE: To improve optical system design to optimize collection efficiency.

DESCRIPTION: The current trend in infrared jammers for electronic warfare applications is toward directional systems which focus the radiation from a noncoherent source into a projected beam typically between 5 and 30 degrees. Reflective or a combination of reflective and transmissive optical elements are used. Collection efficiency is not optimal and improvements can be obtained through improved optical system design.

Phase I: Using appropriate design tools, a trade-off of innovative concentrator designs will be performed. A Xenon arc lamp with an input power of 800 + 200 Watts will be used for the baseline source. Collection efficiency will be compared to that obtained with a parabolic reflector. The goal will be to optimize and uniformly distribute source radiation in a cone of 15 degrees. At the end of Phase I, a single design will be selected and an implementation plan to test that design in Phase II will be prepared.

Phase II: The optical elements recommended in Phase I will be fabricated along with a Xenon source. Radiometric measurements will be performed to assess collection efficiency. The design will be iterated if further improvements are required. At the end of Phase II two sources will be built with the form factor and electrical power requirements specified by the Government and will be delivered for evaluation. (The execution of Phase II would require a SECRET level clearance.)

A91-058 TITLE: Signal Decomposition

CATEGORY: Exploratory Development

OBJECTIVE: Develop and implement a method to decompose a complex signal into its simpler additive components. The comprehensive software package developed in Phase II will be installed in a computer in Government facilities and Government personnel trained on its use. Phase III will address implementation in existing and future target ID systems.

DESCRIPTION: The usual approach used in the area of Automatic Target Recognition (ATR) is to acquire a signal that presumably contains some form of target signature and then extract the signature to recognize the target. In many instances, the signature consists of several additive components which could form a function basis. The usual problem is that due to the additive effects of several of the functions in the basis, the signature can be confused with the already present noise in the signal. The problem of signal decomposition is not a new one. Several techniques have been developed in the areas

of Advanced Signal Processing and Computing (e.g. adaptive filters, model based spectrum estimation and matched filters) and in the areas of Artificial Intelligence and Neuroscience Technology (e.g. neural networks). However, some conditions not usually valid in the ATR problem are assumed in some of these techniques (e.g. stationary signal, complete knowledge of the basis functions, order of transfer function, etc.).

Phase I: Determine which of the previously mentioned areas will be further developed or establish new areas which can be developed to solve the signal decomposition problem. Develop the selected areas enough to provide an indication of which of the different techniques have a potential payoff and the conditions assumed for each.

Phase II: Finalize the theory development of the selected areas and implement them in software. Perform an extensive and comprehensive evaluation of the different techn iques using actual sensor data. The final software package will be installed in Government computer facilities and at least two engineers trained on its theory, implementation and use.

A91-059 TITLE: Automation of Software Management Metrics Application Cycle

CATEGORY: Engineering Development

OBJECTIVE: To develop a reconfigurable automated environment for applying software management metrics to various process models and various BAS mission domains. This will also include investigation and implementation of methods for reducing the cycle time between the point at which data is collected and assessed, and the "injection point" at which corrective action is introduced into the cycle.

DESCRIPTION: There is a critical need to furnish project managers with high-level insight into quality, productivity, and performance characteristics and trends of their software life cycle processes and emerging products. This can be accomplished through use of software management metrics and indicators. A cost-effective and efficient application methodology and corresponding techniques for implementing management metrics and indicators must be developed, prototyped and transferred into use. The application cycle to be investigated in this effort consists of the following components: data collection and formatting; aggregation into management metrics and indicators; analysis of characteristics, trends and interelationships; assessment of results of previous corrective actions; identification and reporting of problems and trends; predictions; decision aids to arrive at corrective action recommendations; management reporting and communications; self-evaluation of the application process itself as to benefits to the current project; a current project database; and, a lesson learned database. Other technical considerations include: reducing the delay between the data points and their corresponding injection points; ability to reconfigure the environment for application to various process models; ability to reconfigure for application to various defense mission domains; and, assuring homogeneous communications between all parts of the environment and the user community.

Phase I: Demonstrate proof-of-concept and feasibility. Develop a plan of approach. Address risk and technical alternatives.

Phase II: Develop prototype of the environment and demonstrate on pilot projects of at least two types of development processes and two categories of mission domains. Develop technology transfer mechanisms such as informal seminars and hands-on tutoring, and, automated scenarios (management games).

A91-060 TITLE: Object-Oriented Databases and Ada Real-Time Applications

CATEGORY: Exploratory Development

OBJECTIVE: There are certain Ada real-time applications, such as some avionics systems and those using knowledge bases, that need to access a database during the course of their operation. Databases

do not normally provide information within the time-critical constraints that are inherent in a real-time system. Object-oriented approaches to database implementation could provide a better response time but have not matched well with the Ada language. The objective of this effort is to develop the technology necessary to effectively combine Ada programs and object-oriented databases, and to have the solution be portable across Ada applications and/or object-oriented databases.

DESCRIPTION: Software is a major component of most tactical Army systems currently in the field or in development. The Army's mandate for the use of the Ada programming language and the parallel emergence of object-oriented concepts and methods in the development of software applications has caused concern about the effective combination of Ada and object-oriented programming. Further constraints are imposed by the time-critical and performance requirements of embedded real-time software systems. These software systems are complex and many are distributed. Future generations of real-time Army systems will also have to be increasingly intelligent.

One approach for Ada real-time applications to use object-oriented databases is to have an Ada interface to an object-oriented database that would allow the application to access the information in the database. This interface would need to provide fast response to rapidly changing data and a method to eliminate the critical bottleneck that can occur when attempting to access or update stored data. It also has to be portable so it can be used by different Ada applications needing to access various object-oriented databases. However, the overhead and effect on performance incurred by having an additional layer introduced needs to be addressed. Approaches to creating this interface and making it portable could include the development of tools to assist in the process. Specific topics to be addressed include: the characteristics and requirements of real-time databases, such as data becoming inconsistent without updates and deadlines associated with transactions to maintain temporal consistency; analysis and characteristics of existing object oriented databases; the Ada 9X language revision that may address object-oriented concepts and Ada; and approaches to combine the two technology areas with the resultant problems and benefits.

Phase I: This research will analyze the issues involved in integrating real-time Ada applications and object-oriented databases. It will propose a solution what will answer as a minimum the issues described in this solicitation.

Phase II: A prototype of the proposed solution will be implemented, evaluated, and tested for validity and ability to address the issues.

A91-061 TITLE: Reuse Metrics

CATEGORY: Exploratory Development

OBJECTIVE: To develop a means of measuring the reusability of a software asset. The subject software asset could be coded modules, software designs, requirements, or any other artifact of the software development process.

DESCRIPTION: Software reuse has the potential for reducing the effort, and related cost, necessary to develop new C3I software. There are costs associated with reuse that include: development of reusable assets; incorporation of the asset into the proposed software; and determination of what appropriate assets are available. The ability to quantify the reusability of a software asset will aid in making decisions concerning which assets are available for use. A quantified means of measuring reusability can help potential re-users in determining the amount of effort needed to reuse an asset. The more reusable an asset, the less effort required to use it. Other possible uses of such a set of metrics includes determining the changes needed to improve the reusability of a software asset, and selection of assets for software libraries.

The proposer should identify the characteristics which affect or influence the potential reusability of a software asset, and the related evaluation criteria or indicators, the associated values for these

indicators, and different approaches for measuring these indicators with automated tools.

Phase I: Phase I will concentrate on defining and describing the indicators to be measured, their values, and the preferred measurement method. A measurement methodology which produces a range of values as opposed to a go/no-go or pass/fail score is preferred. A detailed report will be delivered at the end of Phase I.

Phase II: During Phase II a prototype of an automated tool for evaluating software assets will be developed and delivered. This tool will evaluate the software asset for the reuse indicators developed in Phase I. The tool will determine the values of the indicators and determine the reusability of the software asset. An operational prototype will be delivered.

A91-062 TITLE: Model Fusion

CATEGORY: Exploratory Development

OBJECTIVE: Develop an expert system to guide construction of higher level communications models from detailed lower level models of system components. The expert system developed in Phase II will be installed on a 386 class computer or Sun workstation.

DESCRIPTION: Simulation of the interaction between major battlefield systems is feasible only with the use of high level models of each major system. Constructing simulation models of complex systems, e.g. Corps-sized communication networks, is mismatched to the real world specifications that form the primary model referents. Casting the detailed internal rules of system components into hierarchal formalisms such as Zeigler's Discrete Event System Specification(DEVS) is an overwhelming task. At present, the only recourse is to guess some plausible model form and validate that form statistically from certified lower level models whose mass of detail precludes their use in interoperability experiments.

Phase I: Develop an expert guided approach to constructing high level models using detailed models of Army communications systems in the CECOM inventory as the ground level basis.

Phase II: Design and encode the proposed expert guide for implementation on a 386 class computer of Sun workstation.

A91-063 TITLE: Integrated Photonics Research

CATEGORY: Exploratory Development

OBJECTIVE: Develop a method for electronically isolating different photonic components on the same substrate. The method developed will be implemented on a device for use in an Army communications subsystem.

DESCRIPTION: Monolithic integration of multiple photonic and electro-optic devices on the same substrate has long offered the promise of devices with smaller size, lower power consumption, and higher information capacity. One problem with this integration is the growth of dissimilar materials and device structures on the same substrate. However, even if these problems are solved, problems with electronic isolation may remain. For example a semiconductor laser operates with a forward electronic bias, a P-I-N optical modulator operates with a reverse electronic bias; in order to operate these devices side by side some method for electronic isolation must be provided.

Phase I: Develop a method for electronically isolating different photonic components on the same substrate. The method should be compatible with semiconductor growth and processing techniques. The Phase I report should include candidate devices with which the method can be tested. The report should also include an analysis of performance advantages gained by using the integrated device over a hybrid counterpart, as part of a fiber optic communication link.

Phase II: Test the method developed in Phase I by growing/manufacturing an integrated photonic device and testing it against a hybrid device of similar functionality. Advantages should be quantitatively documented; i.e., reduced input device power reduced Bit Error Rate (BER) for a given fiber link, etc.

A91-064 TITLE: Human Factors Solutions for Soldier's Computer

CATEGORY: Exploratory Development

OBJECTIVE: To seek innovative solutions to some of the many human factors issues facing implementation of the Soldier's Computer.

DESCRIPTION: The Soldier's Computer will be a pocket size computer which will use a helmet-mounted display and a hand-held input device. Additional capabilities will include voice recognition, global positioning system, embedded training, paperless manuals, medical monitoring, message management, video image transmission, and various sensors.

A partial list of some of the human factors issues includes: 1) head-mounted display issues including ambient light, disorientation, blocked vision, helmet weight/imbalance; 2) Computer input devices to be used while walking, crawling, or when boths hands are occupied; 3) Soldier-to-soldier communications through utilizing of voice radio, e-mail, voice mail, and multi-media; 4) Computer graphic interface, information content and presentation, and information overload. Offerors need not as part of their submissions propose actual solutions but should emphasize their potential to do so if awarded this contract. This contract would be a good opportunity for an individual human factors scientist with aspirations of establishing a research company; however, small businesses of all sizes are encouraged to propose. Facilities and equipment at CECOM, Ft. Monmouth, NJ and at other government installations may be available for research and testing. Offerors specifically need not have an electronics background.

Phase I: Assess all existing research that relates to area. Identify all major human factors issues relating to the Soldier's Computer. Propose innovative solutions(hardware, software, training, procedures, etc.) as well as a means of testing and evaluating such concepts.

Phase II: Conduct research, testing, and evaluation of innovative solutions as proposed in Phase I. This may include the fabrication of hardware items, the development of software, the development of training materials, or the proposal of new military procedures. The goal of Phase III is both follow-on research as well as the sale of items to the government and commercial market.

CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

A91-065 TITLE: Detection of Threshold Amounts of Microorganism Specific Proteins Using a Hand-Held Electrochemical Sensor

CATEGORY: Exploratory Development

OBJECTIVE: Use or conversion of chemical energy transfer systems for recognition of the presence of microorganisms. Disposable insertion strips will distinguish major groups of microorganisms based on a common inter-group characteristic for each major category.

DESCRIPTION: Currently, there is a need to assess the presence ofbacterial pathogens in an aerosol, in contaminated water, or in a biological warfare agent chemical cloud. There are no easily transportable devices that would allow a soldier to obtain such information. Biochemical sensors have

been constructed using immobilized enzyme systems which function when the transfer of an electron is converted into an electrochemical signal and displayed by a hand-held sensor. Glucose determinations can be made this way by using the ExacTek system. The recent discovery and isolation of bacterial enzyme systems and cytochrome enzyme systems, which function by the transfer of electrons from one to several compounds, has opened new possibilities for detecting and monitoring reactions occurring in biological systems. A scheme
for such a system, to detect and separate major categories of microorganisms, will provide the theoretical basis for construction of an universal electrochemical sensing device which will read all signals.

Phase I: Work during Phase I should center around establishing a theoretical basis for recognition of spores, viral particles, bacteria, amoeba, and fungi using unique electron transfer reactions. A disposable strip, specific for each group, will be designed to generate the same end result and be read in the universal sensor. Thus, the identity of groups will be designated by the disposable strip itself. For example, a strip containing an enzyme system which will detect a component found in fungi cell walls, such as sterols, which are not found in any other group, will be inserted in the device and read. If a negative reading is obtained, then each of the other three strips are inserted, inoculated, and read. The system will be designed to detect a threshold number of particles, significantly above background, to avoid an unacceptable number of false positive reactions.

Phase II: Phase II should see the successful proof of concept of reactions developed in Phase I as they are transferred to a read device. This device will be small enough to be carried in a shirt pocket, along with a packet of disposables. It must be easy to calibrate and indicate improper functioning to the user.

A91-066 TITLE: Optimized Production of Bacterial Agent-Degrading Enzymes

CATEGORY: Exploratory Development
OBJECTIVE: Optimization of the culture growth conditions for maximum production of bacterial decontaminating enzymes and development of purification procedures for the rapid and efficient purification of these enzymes.

DESCRIPTION: A number of bacterial sources for chemical warfare agent degrading enzymes have been discovered by researchers at CRDEC. This project would entail the use of one or more of these microorganisms for fermentation optimization and protein purification studies. (Agent facilities will not be required)

Phase I: The desired results would include a large scale screening, in shake flasks or small scale fermentors, to determine optimum conditions for growth (temperature, pH, media components, etc.) that also yield the highest levels of enzyme activity. An assay procedure for detection of activity will be selected in advance by consultation with CRDEC researchers. Preliminary protocols are to be developed for the purification of the subject enzymes. Major emphasis will be on innovative techniques that will be rapid as well as giving a high yield and recovery of activity.

Phase II: The growth conditions determined in Phase I will be scaled up to medium or large scale fermentor systems and optimization confirmed. Using the large quantities of cells resulting from these studies, the innovative procedures that have been developed will be used to produce large amounts of purified enzymes that can be used for test and evaluation studies. The amount of enzyme, degree or purification and number or enzymes
will be negotiable and depend to some extent on the results of Phase I.

A91-067 TITLE: Encapsulation of Energetic Materials, Strong Reducing Materials

CATEGORY: Basic Research

OBJECTIVE: Demonstrate thin-walled polymeric encapsulation of aluminum alkyls with nominal capsule diameters in the 3-5 mm and 80-150 mm size ranges.

DESCRIPTION: The goal of this effort is to demonstrate the feasibility of thin-walled encapsulation of aluminum alkyls, typically trimethylaluminum, triethylaluminum, and triborohydride aluminum. The two sizes of interest are 3-5 mm nominal capsule diameter (approximate volume of 0.1 to 0.6 milliliters) and 80-150 mm nominal capsule diameter (approximate volume of 0.25 to 1.75 liters). The desired shape of the resulting capsule is a smooth irregular shape with a major to minor axis (length to diameter) ratio between 1 and 3. It is also desired that the encapsulating material be pliable under inert or storage conditions and upon initial exposure to the atmosphere, the encapsulating material would harden to form a frangible shell.

Phase I: Identify materials and encapsulating techniques to demonstrate encapsulation of triethylaluminum in the 3-5 mm and 80-150 mm diameter ranges. It is desired that the resulting capsules meet the description given above.

Phase II: For 3-5 mm capsules: Introduce a tacky cohesive fluid to form an agglomeration of capsules which will flow and stick together when poured out of a storage container onto a flat surface. The material should be tacky enough to pick up dirt and ambient debris. It is required that the capsules be tough enough to withstand dissemination shear but become frangible after a period of time so that they break open under 20-50 pounds per square inch pressure. For 80-150 mm capsules: Introduce a tacky fluid which will be adhesive enough to pick up dirt and ambient debris but will not cause agglomeration of the capsule mass. It is required that the capsules be tough enough to withstand dissemination shear but become frangible after a period of time so that they break open under 20-50 pounds per square inch pressure. It is desired that a solvent/shock sensitive component be added so that upon evaporation of the solvent the encapsulated mass becomes sensitive to explosive implosion.

A91-068 TITLE: Innovative Dissemination of Powdered Materials

CATEGORY: Exploratory Development

OBJECTIVE: The U.S. Army has a requirement to rapidly and safely disseminate low bulk density powders,in the 1-5 micron particle size, from a small container that has been thrown or propelled into a room. The dissemination method will result in a high efficiency, relatively uniform particle distribution throughout the room.

DESCRIPTION: There is a need to release particulate riot control agent in an enclosed area with minimal possibility of producing injury to the occupants of the room due to either ejected parts from the device or from pyrotechnic material that could initiate combustion. The device will contain a high volume of powder.

Phase I: A study will be undertaken to research and evaluate dissemination techniques that will permit rapid, safe, and effective release of powders from a small container which has been propelled into a room. This phase will result in a demonstration of the method which is considered to be the best candidate for optimizing cloud efficiency while reducing dissemination hazards.

Phase II: The results from Phase I will be used to refine the dissemination system. Hardware designs will be evaluated to optimize the powdered fill in the device and to ensure that regardless of the orientation of the device when it is delivered into the room that the dissemination efficiency will be high. This phase will result in prototype demonstrations for reliability, ruggedness, safety, and effectiveness in rapidly producing a uniform dispersion throughout the room.

A91-069 TITLE: Evaluation of Using Protective Coatings to Limit Penetration of

Chemical Warfare Agents Into the Surfaces of Individual Equipment

CATEGORY: Exploratory Development

OBJECTIVE: To evaluate the use of protective coatings to limit the penetration of chemical warfare agents into the surfaces of a soldier's individual equipment.

DESCRIPTION: Current doctrine calls for the soldier to perform hasty decontamination of his individual equipment (i.e., CB protective hood/mask, gloves, footwear, weapon, helmet, and load bearing equipment) to remove gross liquid contamination. Decontamination systems used to perform hasty decontamination of individual equipment (i.e, XM295 Decontaminating Kit, Individual Equipment and the M258A1 Personal Decontaminating Kit) are effective at removing surface liquid contamination, however agent that penetrates the surface will not be removed. The application of a protective coating to limit the penetration of agents into the surfaces of individual equipment will increase overall removal of agent and reduce the vapor hazard created when agents desorb from the individual equipment.

Phase I: A feasibility study would be conducted to evaluate the concept of a field expedient coating that can be easily applied by the soldier to his individual equipment and will limit agent penetration. As part of the study, a market survey would be conducted to identify materials that can provide a protective coating and are compatible with individual equipment and decontamination systems (XM295 and M258A1).

Phase II: The materials that were identified during the Phase I feasibility study and have the greatest potential for use as a protective coating would be tested under laboratory conditions. Testing would address the following:

(1) the capability of the coating to limit agent penetration;
(2) the durability of the coating;
(3) the compatibility of the coating with individual equipment and decontamination equipment; and
(4) the most suitable method of application and the ease of application.

A91-070 TITLE: Investigation of Various Sprayer/Applicator Approaches for Dispersing Powdered Sorbents to Contaminated Surfaces

CATEGORY: Exploratory Development

OBJECTIVE: Investigate various sprayers or applicators that can be used to deliver sorbents onto surfaces contaminated with chemical warfare agents that an individual soldier might need to continue touching in order to perform his mission. The systems to be considered should possess favorable logistics (i.e size, weight, power requirements, etc.) and be used for applying sorbents to vehicle interiors, key areas of vehicles or crew-served weapons, and individual soldier equipment (i.e. boots, gloves, helmet, web gear, rifle, etc.).

DESCRIPTION: Various reactive sorbents are now being developed which possess the capability of quickly absorbing chemical contamination and subsequently destroying or irreversibly binding the absorbed contamination. These reactive sorbents will dramatically reduce the vapor hazard and possibility of agent transfer in comparison to traditional sorbents. A need exists to develop a logistically attractive method for the individual soldier to utilize in dispensing the developed reactive sorbent onto surfaces that he needs to continuing touching in order to complete his mission.

Phase I: Review technology currently available to spray/apply free-flowing powders/sorbents to surfaces of interest. Perform deposition studies with various reactive sorbent candidates onto different contaminated surfaces.

Phase II: Continue optimizing and refining spraying/application system. Conduct field trials on

actual items of military equipment with simulants and assess decon efficacy and degree of vapor off-gassing. Perform live agent decontamination efficacy testing and off-gassing tests on horizontal and vertical painted panels.

A91-071 TITLE: Development of a Compact Raman Spectroscopy System for Chemical Contamination Monitoring

CATEGORY: Exploratory Development

OBJECTIVE: To develop a compact Raman system designed for use as a detector of chemical contaminants on surfaces.

DESCRIPTION: Current detection systems do not adequately address theproblem of detecting chemicals on natural and man-made surfaces at short ranges (<0.5m). For current systems to detect a liquid, the contaminant must have a sufficient volatility to produce a measurable concentration in the air above the surface. Persistent threat agents and solid contaminants have very low vapor pressures, however, making their detection problematic. The advantages of an optical detection technique over current vapor sensing schemes would include the direct detection of the liquid or solid contaminant on the surface as well as freedom from memory effects that result when the sample must be ingested into the detector. Raman scattering has been used to remotely detect species in the atmosphere at part per million (ppm) levels. At a distance of 1 kilometer or greater, however, high energy pulsed lasers and large diameter collection optics are required. Because of the signal dependence on one over the square of the distance from target to observer, a factor of 100 million improvement in sensitivity is realized for detection at 10 cm as compared to detection at 1 km. Calculations using laboratory measurements of chemical agent Raman scattering cross sections indicate that the detection of agents on surfaces is possible with laser powers less than 50mW. With the recent advances in array detectors, and diode lasers, construction of a sensitive and compact Raman based detector appears feasible. In addition to its military role of monitoring and control of chemical warfare agent contamination, such a system would be applicable to the rapid identification of chemical spills at chemical plants, land fills, etc.

Phase I: The goal of the Phase I study will be to determine the feasibility of developing a compact Raman spectroscopy system capable of detecting liquid and solid contaminants on surfaces at coverages of approximately 1 gram per square meter. The system design produced in Phase I will contain specific information on components as well as total size, weight, and power requirements. The decision to move into Phase II will be based on the perceived utility of the Raman detection system as designed.

Phase II: The goal of Phase II will be the actual construction and testing of a compact Raman system for contamination monitoring. A system will be built from the designs produced in Phase I and tested to determine its actual sensitivity to liquid and solid surface contamination.

A91-072 TITLE: Continuous Unattended Air Monitoring

CATEGORY: Exploratory Development

OBJECTIVE: To develop a medium and long term air sampling technique (one week to several months) for chemical warfare agents and other volatile organic materials.

DESCRIPTION: There is an immediate need for improvement in historical air quality monitoring to furnish supporting and conformational sampling for use in conjunction with the Automated Chemical Agent Monitoring System (ACAMS) and MiniCAMS type instrument. There is also a need for a continuous sample record for both Military Unique substances and EPA volatile and semi-volatile

compounds. The current method of solid sorbent sampling at chemical agent munition disposal sites seems to provide a sound starting point for the development of such a system to meet these meeds. The ideal approach would include highly automated sampling and analysis, provide a wide range of sampling paramcters, and perhaps include remote as well as local control options.

Phase I: Desired results for the initial portion of the work would be to provide data on both a reasonable technological approach and analysis guidelines. Solid sorbent materials would be evaluated for their retention characteristics for each of the potential target compounds.

Phase II: Desired results for the later stages of the work would be system integration and further method development leading toward field validation.

A91-073 TITLE: Development of Chemical Sensor System Capable of Automatic, Long Term Monitoring of Chemical Agents at Very Low Concentrations

CATEGORY: Exploratory Development

OBJECTIVE: To explore the use of solid state chemical microsensors, in combination with powerful microcomputers, to develop a new class of chemical detectors that will meet the long term, low level (< 0.01 mg/m3), chemical monitoring requirements of Treaty Verification and Chemical Demil operations as well as the perimeter monitoring of sites such as Agent Storage Facilities.

DESCRIPTION: A more effective chemical agent sensor system is needed to meet the new, strict requirements for monitoring Treaty Verification and Chemical Demil operations. These requirements include long term, continuous monitoring for low levels (below 0.01 mg/m3) of chemical agents. The same chemical monitor would also meet the requirements for local and perimeter monitoring of the many Army chemical development, test and storage (depot) locations. The new sensor systems would be very rugged, require low maintenance (a minimum of 1,000 hours of continuous, maintenance free operation), require no consumables other than power, have a long shelf life (greater than five years), and be capable of monitoring a wide range of chemical agents, their precursors and decomposition products. The system should be microprocessor based and able to provide the option of either automatic or manual operation, and for local or remote control and communication. The options for remote communication should include the capability for telephone modem and RF transmission, as required.

Phase I: Desired results for the Phase I effort should demonstrate that a microprocessor based chemical sensor system can be developed that will meet the above requirements for long term, continuous chemical agent monitoring.

Phase II: It is anticipated that the Phase II effort will result in the design and fabrication of a new chemical sensor system for long term chemical monitoring that is ready for extensive field testing and ultimately for production and use by the Army in a variety of applications.

U.S. ARMY MISSILE COMMAND

A91-074 TITLE: Deformable Mirror Spatial Light Modulator Based Infrared Projector for Hardware-in-the-Loop Simulation Applications

CATEGORY: Exploratory Development

OBJECTIVE: An IR projection system for use in HWIL simulations.

DESCRIPTION: Several weapon systems are currently under development throughout all branches of DoD which utilize imaging IR focal plan arrays (FPA) for target detection and intercept. Conventional

IR projector performance limitations have forced the exclusion of the FPA hardware from the HWIL simulations which are necessary to adequately assess weapon system performance. Therefore, innovative IR projection techniques are needed to overcome these limitations. Advances in integrated circuit technology have recently made large monolithic DMDs possible. Broadband SLMs appear to be an obvious extension of this technology and accordingly could lead to the development of an innovative IR projection system for application in HWIL simulations.

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

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

A91-075 TITLE: Improved Performance Integrated Optics Components for Fiber Gyroscopes

CATEGORY: Exploratory Development

OBJECTIVE: To advance the development and fabrication of fiber optic directional couplers and "pigtailed" integrated optical circuits for fiber gyroscopes that result in improved performance at low cost.

DESCRIPTION: Lithium Niobate integrated optics (IO) circuits, fabricated by Ti-diffusion and proton exchange, are currently being produced in limited quantities and appear to be acceptable for many applications. However, improved device packaging and fiber "pigtailing" techniques must be developed before fiber optic gyroscopes will have a significant impact on markets requiring low cost, small, ruggedized, three-axis rotation rate sensors operating in the moderate-to-intermediate performance regime. The Inertial Systems Group of the Guidance and Control Directorate is presently conducting an applied research and development program for integrated gyroscopes. There is a need for small, low cost, high performance IO components that are stable over military environments.

Phase I: First phase objective for proposed task is to develop an approach for fabricating small size IO circuits and fiber optic directional couplers (to be used in 2" and 3" diameter systems) that leads to improved overall performance at the lowest possible costs. Devices operating at 0.8, 1.3 and 1.55 microns shall be considered. Develop a method to "pigtail" and fusion splice the devices in a cost effective manner.

Phase II: Second phase objective for proposed task is to design high performance IO circuits and fabricate prototype devices. Evaluate the performance characteristics of the devices. Provide a detailed set of the procedures, including a description of the necessary equipment and facilities for producing small high performance IO components in large quantities.

A91-076 TITLE: Multipath Suppression Techniques

CATEGORY: Exploratory Development

OBJECTIVE: To develop multipath suppression techniques for low angle millimeter guidance of missles.

DESCRIPTION: Multipath suppression techniques are needed in order to support radar guided close-combat missile applications. The system scenario would involve a launcher based W-band radar tracking a missile (single scatterer) and ground armor and low angle air targets (multiple scatterer). The radar would issue differential guidance commands to the missile to accurately guide the missile to the target. The aperture of the radar would be limited to 60 centimeters in diameter. Multipath is the interaction

of reflected terrain bounces with the direct radar signal path to and from the missile and the target. Multipath is the primary source of angular tracking error for low angle target engagements. The suppression techniques developed under this investigation should be applicable to reducing both the multipath error associated with the missile and the complex target since differential guidance is being utilized. High range resolution error reduction techniques may be considered for the target.

Phase I: Multipath suppression algorithm development and verification test path definition. Deliverables shall include reports and a description of any computer codes utilized.

Phase II: Further refinement of suppression algorithm and development of test hardware needed for verification of the algorithm. Conduction of algorithm verification experiment and documentation of data analysis. Deliverables shall include reports, test hardware, and any computer codes generated or utilized.

A91-077 TITLE: Integrated Autonomous Target Acquisition System

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate through the use of advanced processors and algorithms improved performance capabilites of an integrated suite of diverse target acquisition sensors for autonomous lightweight weapon platform applications.

DESCRIPTION: Several target pattern recognition and cueing implementations have been implemented previously based on classical statistical pattern recognition methodology. The performance of these techniques typically demonstrate a significant false alarm rate. The consumption by human operators or an autonomous missile system of significant false alarms has demonstrated a clear detrimental performance effect.

The development of synthetic discriminant functions (SDF) for the purpose of target acquisition, optimum aimpoint selection and non-cooperative target recognition on tactical missile applications emphasized the potential usefulness of these in an integrated approach. Current moving target indication (MTI) techniques have also shown significant potential in an integrated system for target detection when sensor motion is also present.

Phase I: The contractor shall design, develop and implement an optimal pattern recognition methodology using an optimized algorithmic architecture. Several methodologies shall be compared such as evidential reasoning with uncertainty, classical statistical pattern recognition, neural networks, knowledge based pattern recognition, synthetic discriminant functions (SDF), passive moving target indication (MTI) and artificial intelligence techniques. These independent pattern detection and recognition systems have their own capabilities and limitations, however, when combined appropriately and synergistically they potentially provide a superior and significantly robust target acquisition capability.

Phase II: The design and development of an integrated automatic tactical target acquisition system using many complementary and reinforcing methods are required to perform effectively under battlefield conditions. Current ATR systems have false alarm rates which exceed human limits and therefore autonomous requirements. A parallel design implementation of an optimal incorporation of theoretical processes shall provide the necessary synergism and high throughput in the design.

A91-078 TITLE: Dynamic Precision Phase/Amplitude Controller

CATEGORY: Exploratory Development

OBJECTIVE: The purpose of this task is to devlop a precision phase and amplitude controller for use in modulating test signals that will be injected into the RF ports of phase interferometers. The device will be integrated with an existing test facility to provide the capability to covertly test developmental

direction finding hardware. The controller must be accurate within .1 degrees over 360 degrees of phase and .1 dB over a dynamic range of 30 dB. The device must be compatible with a VME bus interface and provide dynamic control and internal calibration.

DESCRIPTION: A means of precisely controlling the relative phase and amplitude of radio frequency signals is required in order to test phase interferometer direction-finding devices. Signals emanating from a common source will be split into multiple paths with each path being phase shifted and attenuated by the control device with dynamic controllability over 360 degrees of phase and 30 dB of amplitude to a resolution of 0.1 degree and 0.1 dB respectively. The following controller characteristics are required:

a. Instantaneous Bandwidth: 1 GHz or more.
b. Internal build-in calibration and test.
c. Digitally controllable via a VME bus.
d. RF input and output via standard coaxial cable connectors.

Phase I: Design the controller and produce a report containing the concept description and detailed specifications of components, construction and test plans.

Phase II: Fabricate, install and demonstrate the hardware resulting from the Phase I design.

A91-079 TITLE: Development of a Compact Hardened Dye Laser

CATEGORY: Exploratory Development

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

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

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

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

A91-080 TITLE: Non-Intrusive Technique for the Measurement of Fluctuating Density, Temperature, and Species Concentration in Turbulent Supersonic Flows

CATEGORY: Basic Research

OBJECTIVE: To measure the high frequency, fluctuating components (as opposed to the mean components) of density, pressure, temperature, and species concentration in high Mach number, low static pressure, low static temperature, multi-species flows with mixing.

DESCRIPTION: There exists a need to measure the high frequency, fluctuating components (as opposed to the mean components) of density, pressure, temperature, and species concentration in high Mach number, low static pressure, low static temperature, multi-species flows with mixing.

Current optical techniques including laser induced fluorescence (LIF) and Raman scattering (CARS and SRS) offer promise for the measurement of fluctuating density, temperature, and species concentration since these techniques are non-intrusive and have been used in a supersonic wind tunnel

environment to determine mean values for the above properties. Unfortunately, current laser techniques do not work well in most high supersonic wind tunnels because of the low static pressures, low static temperatures, and high stagnation temperatures in the test section; temperature distortion and abrasion of test section windows; and the high vibration environment surrounding the tunnel. Furthermore, modest laser pulse rates and low response signals have precluded the determination of fluctuating properties even at low supersonic Mach numbers. This effort would entail innovative adaptations of current optical techniques to develop a system suitable for fluctuating static density, static temperature, and species concentration measurements in high Mach number, low static pressure, low static temperature, multi-species flows with mixing.

Phase I: A non-intrusive measurement system would be designed to measure fluctuating static density, static temperature, and species concentration in a Mach 10, 1250 K stagnation temperature, 60 K static temperature, 1 torr static pressure flow. The system will be built, assembled, and bench tested in a laboratory environment for system design verification.

Phase II: The system designed in Phase I would be assembled for testing in a Government wind tunnel facility.

A91-081 TITLE: Thrust Augmentation System for Low Cost Expendable Turbojet Engine

CATEGORY: Exploratory Development

OBJECTIVE: To develop a system to significantly enhanse the thrust of a missle turbojet engine in order to provide boost thrust for the flight vehicle.

DESCRIPTION: Low cost expendable turbojet engines have been developed as the sustainer propulsion system for extended range tactical missiles. In their present configuration, these engines have insufficient thrust to act as the booster propulsion system and consequently a separate solid rocket motor is required to achieve flight speed. Technology is required to provide on-demand thrust augmentation such that a low cost expendable turbojet engine can function as a integrated, high efficiency tactical missile boost/sustain propulsion system. A thrust augmentation system is required that increases that full power static sea level thrust of an existing low cost expendable turbojet by a minimum of 100%. This augmentation system must be readily adaptable to an existing engine, must provide boost thrust on-demand, must allow the turbojet to operate in a low thrust sustainer mode, and must be suitable for integration is a tactical missile with a 7.0 inch airframe diameter. For the Phase I effort, the augmentation system must be configured for operation with either the Sundstand Power Systems model TJ-90 or the Williams International Model P8910 turbojet engines.

Phase I: The Phase I objective of the proposed effort is the design, fabrication and delivery of a heavy-wall augmentation system. The augmentation system shall be delivered to the Government for integration with a turbojet engine and evaluation testing.

Phase II: The Phase II objective of the proposed effort is the design, fabrication and delivery of a flight-weight, augmented turbojet based, boost/sustain tactical missile propulsion system. The propulsion system shall be delivered to the Government for evaluation testing.

A91-082 TITLE: Infrared Wavelength Beam Combining Techniques for Multi-Color Projector Application

CATEGORY: Exploratory Development

OBJECTIVE: Design and development of a novel IR signal combiner which utilizes available optical components and materials for use in HWIL simulations of multi-color IR missile systems.

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

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

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

A91-083 TITLE: Incorporating Digital Modulation into a Digital RF Memory System

CATEGORY: Exploratory Development

OBJECTIVE: The purpose of this task is to develop digital hardware capable of multiplying, in real-time, digital RF memory samples of in-phase and quadrature video waveforms by a modulation function to simulate radar echoes from targets and clutter, ECM, Jet Engine modulation, and passive CM. Ths system must have 8 bits resolution, delay the signal no more than 100 nanoseconds, and output at a 250 megarhertz rate.

DESCRIPTION: Digital RF Memory Systems have been developed for delaying RF signals in hardware-in-the-loop simulations of airborne radar systems. These systems sample in-phase and quadrature (I & Q) components of the RF waveform at high sampling rates and store the samples in a digital memory. After a prescribed time delay, the waveform is reconstructed by converting the digital samples to analog voltages at the sampling rate. It is desirable to provide digital modulation of the I and Q waveform samples before reconstructions to simulate clutter, multipath, jet engine modulation, ECM, and other types of radar signals. The modulation can be accomplished by multiplying the digital I and Q waveform samples by digital modulation samples. The digital modulation requirements are the following:

1. Modulation Resolution: 8 bits, minimum
2. Modulation Rate: 250 MHz, minimum
3. Additional Signal Delay Due to Modulation: 100 nsec, maximum

Phase I: Provide design, analysis, and computer simulation to verify the performance of the proposed design.

Phase II: Build a prototype and demonstrate the system performance in both static and real-time modes.

A91-084 TITLE: Infrared Laser Diode Based Infrared Projector

CATEGORY: Engineering Development

OBJECTIVE: Design and development of a novel IR projector which utilizes available laser diodes in the mid wavelengths for use in HWIL simulations of IR missile systems.

DESCRIPTION: Several weapon systems are currently under development throughout all branches of DoD which utilize multiple IR wavebands for target detection and intercept. Typically linear arrays of detectors with less than 30 total detectors are used in these systems. These are scanning systems with

small instantaneous fields of view. As the system optics scans the total field of view the detector elements are read out at extremely high rates. Conventional IR projection techniques cannot support the modulation of the IR signal outputs at the rate required for accurate Hardware-In-The-Loop (HWIL) tests of these systems. These performance limitations have forced the exclusion of the IR detectors from HWIL simulations which are necessary to adequately assess weapon system performance. Therefore, innovative fast IR projection techniques are needed to overcome these limitations. Currently, IR laser diodes are available in the short to mid wavelengths which are fast enough to test these systems. However, low output power levels limit their utility. Accordingly, if power levels could be improved and extensions made into the long wavelengths, an IR projector capable of supporting HWIL tests of these systems could be developed.

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

Phase II: Extension and upgrade of the laboratory demonstration laser diode projector for use in Hardware-In-The-Loop simulations of IR missile systems.

A91-085 TITLE: Sensor Fusion for Detection Cueing and Classifiecation of Airborne and Ground Targets

CATEGORY: Exploratory Development

OBJECTIVE: Develop sensor suite using present sensors and determine sensor suite performance.

DESCRIPTION: Threat targets utilize nap of the earth and clutter to screen themselves from conventional ground based surveillance systems. Fused, integrated sensor suites on missile weapon launch platforms are needed for detection, cueing and classification of these threats so that fire, counterfire or avoidance can be implemented by our weapon systems. Concepts may utilize active or passive sensors, however, the emission levels of the launch platforms that carry the sensor suites are an important consideration.

Phase I: Concept description and feasibility studies that predict sensor(s) performance or sensor suite performance to distances greater than 8 kilometers are required. Measured data when available should be utilized in the studies. Deliveries shall include reports and any computer codes utilized.

Phase II: Sensor(s) and signal processing hardware and software to demonstrate the concept and demonstrate performance in field experiments.

A91-086 TITLE: Remote Sensor for Surveillance and Data Collection

CATEGORY: Exploratory Development

OBJECTIVE: To develop a remote sensor to collect video imagery, to be used in conjunction with field tests of an optical correlator system.

DESCRIPTION: A remote video sensor system is required for surveillance and data collection applications. The system should include a high resolution black and white CCD camera and a high resolution monitor. The sensor system should be mounted on an automated, stabilized, motorized gimbal platform for use with a tracking system.

Phase I: The objective of the first phase is to design and specify a prototype system consisting of a gimbal platform, CCD camera, monitor, and zoom lens. The electronics necessary to provide manual control of the zoom and joystick control of azimuth and elevation should be included in the design and evaluation.

Phase II: The objective of the second phase is to construct and test the prototype designed in

Phase I.

A91-087 TITLE: Advanced Kinetic Energy Penetrator Concepts for Kinetic Energy Missiles

CATEGORY: Exploratory Development

OBJECTIVE: To develop an advanced penetrator capable of withstanding the high bending moments induced by high obliquity and reactive armor targets. The penetrator should provide a robust capability against future threat vehicle armors.

DESCRIPTION: Advanced kinetic energy penetrator concepts are needed for a future generation of Kinetic Energy Missiles. These missiles are expected to be roll stabilized, and deliver the penetrator to the target at velocities of 2000 - 2500 meters per second. The penetrator will be subjected to approximately a 1000 G maximum axial acceleration during the burn of the propulsion system. The missile packaging envelope will permit the penetrator to be less than 1400 millimeters long, less than 40 millimeters in width, and less than 6.5 kilograms in weight. The penetrator concepts should defeat tank armor which uses advanced explosive reactive armor in combination with advanced laminate armor technology.

Phase I: The Phase I objective is to perform and document the concept definition and penetration analysis of penetrator concepts which could be tested in Phase II, and to propose a test plan to be followed in Phase II. The concept definition and analysis should be augmented by comparison with classified and unclassified data available in the literature.

Phase II: The objective of Phase II is to perform the penetrator fabrication and test against advanced armor targets to demonstrate the feasibility of the concepts defined in Phase I.

U.S. ARMY NATICK RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

A90-088 TITLE: Thermoplastic Elastomer (TPE) Coated Fabric for Toxicological Agents Protective (TAP) Suit

CATEGORY: Exploratory Development

OBJECTIVE: Fabrication of a prototype TPE coated fabric for the TAP suit.

DESCRIPTION: Current TAP suit material fabrication process involves mixing of rubber compound, solvent cement preparation, coating, calendering, and curing of butyl rubber coated nylon, MIL-C-12189.

Phase I: A study of adhesion between selected fabric and onto fabric.
Phase II: A short production run (300 yds) for the fabrication of TPE coated fabric.

A90-089 TITLE: Three Year Shelf Life, High Barrier Food Container

CATEGORY: Exploratory Development

OBJECTIVE: To have designed and developed a high barrier plastic container which provides thermoprocessed foods a three year shelf life. This new container could replace those presently used in the Thermostabilized Meal Tray Ration (TMT), which provides only 18 month to two year shelf life. A

three year shelf life would allow the TMT Ration to be stored for the same length of time as other rations in storage warehouses. Services other than the Air Force may therefore find more uses for the TMT, and the result will be increased procurements, lower unit costs, and larger industrial base.

DESCRIPTION: The TMT Ration fulfills and Air Force requirement for a dining hall type of meal to be served to personnel in remote locations. The TMT is a ready-to-eat, thermoprocessed meal which may be heated in hot water or microwave. Unlike other rations, however, the TMT shelf life is limited to 18 months to two years. The limiting factor is the polymeric barrier material used to prevent oxygen and water vapor permeation in the container material construction. The barrier materials presently used in the TMT and in similar commercial items are not designed, either in type, style or thickness, to provide foods with a long shelf life. However, by using new and improved high barrier plastics, or changing the construction of the coextruded material, or increasing the thickness of the barrier layer, a three year shelf life container is attainable.

Phase I: The solicitation of novel ideas that indicate a container (a trilaminate lidstock containing foil is allowable) that can be constructed from polymeric materials which will potentially meet the three year requirement.

Phase II: The development of the sheet stock material, the containers formed from this material, and the demonstration of a three year shelf life through accelerated storage studies.

A90-090 TITLE: Shape Memory/Smart Materials for Stiffened Fabric Wings

CATEGORY: Exploratory Development

OBJECTIVE: Investigate feasibility of using shape memory/smart materials technology to increase the performance of a fabric wing which may be packed in a standard bag and deployed from an aircraft. Reusability is desirable but not critical.

DESCRIPTION: Aircraft survivability is increased by providing an offset capability for personnel and cargo. High performance gliding decelerators/wings are necessary for providing this capability. The lift to drag performance may be significantly increased by selective stiffening of the decelerator/wing. Unfortunately, stiffened fabric wings have, traditionally, been difficult to pack and deploy.

Phase I: The feasibility of using shape memory/smart materials to increase the performance of a fabric wing will be investigated. Recent advances in shape memory materials have overcome many of the problems and limitations of the original nickel and titanium alloys. New materials such as mouldable plastics derived from polyurethane and polymers such as Norsorex have been commercially used by a number of Japanese firms in products for which the Ni-Ti alloys could not be utilized. Phase I work will provide an analysis of the ability of shape materials to increase the lift to drag performance of a fabric wing which may be packed in a standard bag and deployed from an aircraft. The stiffened areas may include the leading edge, trailing edge or any other area where stiffening can be shown to have a significant effect on performance, such as flattening the wing along it's span. The shape memory materials must allow the wing to be stiffened after deployment. The contractor will, in addition to the analysis construct laboratory specimens to demonstrate the feasibility of the concept.

Phase II: Prototypes will be constructed to experimentally demonstrate that the Phase I analytical and experimental results are attainable for a full size fabric wing. Drawings and fabrication specifications sufficient to enable the Army to duplicate units and repeat test results will be provided.

A90-091 TITLE: Manufacture of Superactivated Carbon

CATEGORY:

OBJECTIVE: At lease one process for the manufacture of superactivated carbon with B.E.T. surface area greater than 3000 has been demonstrated on a pilot plant basis but it has not been carried to full scale production. It is the purpose of this SBIR to support industry in producing a superactivated carbon in sufficient quantity for the chemical protective programs.

DESCRIPTION: Natick has tested developmental superactivated carbons and found their use would enable us to reduce the weight, bulk and heat stress associated with current CP uniforms without sacrificing chemical protection.

Phase I: Demonstrate through paper studies, laboratory development, etc. the capabilities of the contractor to produce this product. Included would be a proposal complete with engineering design for the construction of a commercial plant with the capability to produce sufficient carbon to supply all government needs.

Phase II: Provide for the construction of a scalable manufacturing plant capable of supplying sufficient superactivated carbon with a B.E.T. of greater than 3000 and other specified properties in quantities sufficient for the government to develop and evaluate the advantages of this carbon. It is estimated that the requirements would be 4000 pounds.

A90-092 TITLE: Binary Food Heating/Cooling Container

CATEGORY: Exploratory Development

OBJECTIVE: To design, fabricate, and evaluate a prototype device that can simultaneously heat and cool ration components/beverages without a power source.

DESCRIPTION: Methods for heating and cooling foods and beverages without power are of interest to the military for a wide variety of uses and situations. This project is intended to exploit technology of a recently proposed commercial
packaging application.

Phase I: A feasibility study to determine optimum materials and configuration of a handy binary food/beverage container that can simultaneosly heat and cool. The most likely configuration will take advantage of the phenomenon of water in a partial vacuum boiling at low temperatures as a cooling mechnanism to extract heat from the beverage, and then transfering the heat energy to meal components, thus providing a simultaneous heating and cooling action.

Phase II: Develop the binary container using actual ration components for test and evaluation under field
conditions. If a demonstrated success, this mode of packaging could be commercialized for a numerous of attractive military, camping, and transportation industry applications.

A90-093 TITLE: Thermoplastic Elastomer (TPE) Chemical Protective (CP) Gloves By Injection Molding Process

CATEGORY: Exploratory Development

OBJECTIVE: Fabrication of a prototype thermoplastic elastomer chemical protective glove.

DESCRIPTION: Current CP gloves, MIL-G-43976, are made of thermoset butyl rubber. These gloves are made by solvent-dipping process.

Phase I: A study of injection moldability of TPEs for making CP gloves.
Phase II: Selection of TPEs for chemical protection and fabrication of a prototype TPE CP glove.

A90-094 TITLE: Ribosome System for Synthesis of New Polymers for Material Applications

CATEGORY: Basic Research

OBJECTIVE: Development of an in vitro synthesis system which combines portions of the natural cellular biosynthesis system traditionally involved in protein translation to synthesize new nonprotein polymers. Demonstration of new polymer properties tailored based on the monomers incorporated into the in vitro system. Polymers may be used in high strength fibers or composites, exhibit elastomeric properties, or provide specific functional properties such as activity in degrading chemical agent threats or signature reduction properties.

DESCRIPTION: The objective is to harness the normal cellular components used in polymer formation for proteins to be able to incorporate novel monomers into the synthesis of new nonprotein polymers with the control over molecular
weight, sequence, stereochemistry, composition and reactivity exhibited for proteins. These new polymers may find applications in fibers, films and composites desirable for either structural or functional properties.

Phase I: Results will include the demonstration of the synthesis of a new polymer in vitro using protein synthesis systems but without the traditional amino acid monomers. The polymer synthesized will be designed to achieve specific structural or functional properties such as high strength, high elasticity, reactivity against chemical agents or related properties of interest, and the polymer produced will be characterized to determine how close the results fit to the desired goal.

Phase II: The optimization of the system established in Phase I to improve stability of the system, reduce costs of synthesis, and include the processing of the polymer product in a continuous fashion. This Phase will also involve scale up production of a target polymer and the evaluation of its properties. Design considerations to develop more generic polymer synthesis systems will also be included in this Phase.

A90-095 TITLE: Nonplastic Substitute For The Plastic Milk Bladder

CATEGORY: Exploratory Development

OBJECTIVE: To have developed an operationally and environmentally acceptable substitute for the plastic milk bladder currently used in all military and institutional food service systems. This new milk bladder would assist the Navy in meeting the objectives of the MARPOL Treaty banning the overboard disposal of plastic wastes, and reduce plastic waste for the other services.

DESCRIPTION: The plastic milk bladder has been identified as a priority target for replacement by the PRIME (Plastic Removal In Marine Environment) Working Group. The major problem with the milk bladder is when stored after use, the residual milk spoils and becomes both an odor and a potential health problem. Market surveys have not yielded any acceptable substitutes. An acceptable solution to this problem is an environmentally friendly, nonplastic, bulk container, that can be disposed of by standard shipboard practice. The container shall comply with the guidelines in CID - A-A-20113B for Milk and Milk Products dated 12 December 1986.

Phase I: The solicitation of novel ideas that meet the requirements previously stated.

Evaluation will be made based upon the economic feasibility of the ideas. Successful candidates will be identified for Phase II.

Phase II: The development and field testing of the substitute milk bladder.

A90-096 TITLE: Tentage System Thermal Signature Reduction

CATEGORY: Exploratory Development

OBJECTIVE: Existing tentage systems and accessory camouflage is less effective in reducing IR signature than in reducing visual signatures of high value assets behind or beneath tentage. By adopting new tentage materials or modifying camouflage IR signature avoidance performance can be enhanced.

DESCRIPTION: Current camouflage system for shelters and tentage systems need improved IR signature performance characteristics. Advancements in the key emerging Low Observable Technology area have produced materials with enhanced IR signature avoidance characteristics. The feasibility of incorporating these materials into existing tentage systems requires further investigation.

Phase I: The contractor will identify system schemes or materials with enhanced signature avoidance characteristics and determine the feasibility of incorporating such schemes or materials into tentage systems.

Phase II: The contractor will produce a prototype system incorporating the system schemes or materials identified during phase I into either the tentage system itself or into a tentage camouflage product to achieve enhanced IR signature avoidance performance.

TANK-AUTOMOTIVE COMMAND

A91-097 TITLE: Structures for Future Light Ground Combat Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: Determine the feasibility of producing composite structures for future light combat vehicles.

DESCRIPTION: The use of conventional materials in the fabrication of combat vehicle structures inhibit their weight reduction. The concept of using composites in lieu of metals in the production of vehicle structures has often been promoted as a method of weight reduction. What is required is an independent evaluation of the physical and performance characteristics of existing and postulated composites. This would include, but not be limited to, manufacturing processes for the composite, construction process of the structure, feasibility for mass production, ballistic characteristics of composite structures, resistent to NBC decontamination procedures/agents, a comparison of composite(s) verses metal(s) with regard to thickness required to achieve equivalent structural strength and ballistic protection, environmental hazards unique to composites, and costs. The U.S. Army TACOM Research Development & Engineering (RDE) Center is planning the development of Future Light Combat Vehicles which will include input from/guidance to the Material Technology Laboratory (MTL), Aviation Systems Command (AVSCOM), industry and universities to determine the most feasible method of creating composite structures for ground combat vehicles.

Phase I: The contractor(s) would identify all promising composite technologies: both current and potential. This would include materials, structural designs, manufacturing processes, physical and performance characteristics, costs and manufacturing techniques.

Phase II: The contractor(s) would develop the design of a technology demonstrator using conventional subsystems and components integrated into the composite structure. The intent is to

identify the advantages and disadvantages of composite structures.

A91-098 TITLE: Structure Generated Noise Modeling Using Finite Element Analysis (FEA) Techniques

CATEGORY: Exploratory Development

OBJECTIVE: Develop an structural noise prediction model based on the techniques and tools available for Finite Element Analysis.

DESCRIPTION: Finite Element Analysis is a well established methodology that makes possible a predictive analysis of structural system stress, strain and motior analysis based on overall system design and material properties. This complex, but well understood, process can be utilized to predict the sound pressure levels generated by a complex structure under non-linear excitation. Such a process, if perfected, would allow analysts to predict and analyze a critical component of the low-frequency, and subsequently long-range propagating, sound signature of concept vehicles and systems before prototyping. Coupled with other previously developed sound propagation models the vehicle or component designer could adjust various design parameters to minimize structural stress, improving reliability, and the acoustic energy generated by the system, reducing acoustic detection ranges, simultaneously.

Phase I: The contractor(s) would develop acoustic source prediction algorithms, based on current FEA models, for a known input forcing function. These algorithms will be fine tuned and ultimately verified using acoustic and vibration test data collected in an anechoic chamber. More complex structures will be modeled and tested until the vibration-to-sound pressure level transfer functions are well understood.

Phase II: The contractor(s) would test a GCV drive sprocket, under complex dynamic loading, in an anechoic chamber. The acoustic, vibration, input forcing functions, and output shaft load signals will all be collected and compared to the prediction model generated using the previously defined process. The prediction model will be further refined and ultimately inserted into a military system noise prediction model. The following items will be deliverable under this effort: FEA mesh, anechoic chamber test, and all analysis data, test and final reports.

A91-099 TITLE: Unmanned Ground Vehicle Mobility

CATEGORY: Exploratory Development

OBJECTIVE: This project explores the mobility requirements for unmanned ground vehicles. Ultimately, the objective is to identify mobility factors and design considerations unique to unmanned vehicles, then apply these critical elements to optimize future unmanned ground vehicle design.

DESCRIPTION: The U.S. Army and Marine Corps anticipate using unmanned ground vehicles to perform a variety of missions. Examples of these remote operations include reconnaissance, surveillance, chemical detection, mine detection and clearing, decoy, communication relay, weapons firing, and target acquisition. To optimize an unmanned ground vehicles combat effectiveness, the chassis characteristics may differ significantly from current manned systems. The study should focus on a small, rugged, light-weight system. At a minimum, we want to consider: overall configuration, power plant (combustion & electric), power train, frame and body, suspension, steering, electrical power for payloads, electronics and actuators, mobility (speed, ride, & obstacle negotiation), transportability, stealth (acoustic, thermal, and electromagnetic, visual and radar signatures), and reliability (during extended remote operations).

Phase I: The contractor will identify critical elements and technologies for unmanned ground

vehicles and develop a range of concepts optimizing these factors. The contractor must document the concepts in sufficient detail to allow the government to determine if they could satisfy current or future requirements for unmanned ground vehicles. The documentation must include scaled concept drawings, technical descriptions, methodology and work descriptions.

Phase II: The contractor shall fabricate and test a breadboard prototype of one of the their phase I concepts. This vehicle must be controllable by the U.S. Army Multiple Vehicle Control Testbed. The contractor will deliver the following items to the government: breadboard ground vehicle, design drawings, test report, final report.

A91-100 TITLE: High Temperature Military Diesel Tribology Systems

CATEGORY: Exploratory Development

OBJECTIVE: Tribological system, here defined as the lubricant and ring/liner material system, is to be developed and demonstrated for potential application to advanced military low heat rejection engines.

DESCRIPTION: The tribological system shall be designed to operate under high in-cylinder temperature, from 800-1000F at the top ring reversal condition within a low heat rejection engine cylinder. Liquid lubricants should exhibit exceptional oxidative stability at bulk temperatures up to 500F. When contemplating solid lubricant as well as liquid lubricant concepts and ring liner materials, wear rates should be considered whereby an engine lift expectancy of 1000 hours is possible.

Phase I: Initial tribology system concept designs shall be made with friction wear, thermal stability and deposition test data provided as applicable for the design.

Phase II: Bench test results of chosen concept shall be provided. Initial demonstration of the tribology system shall be accomplished on a single or multicylinder engine with operating conditions representative of high output advanced military diesel engines currently being designed.

A91-101 TITLE: Exhaust Generated Noise Modeling

CATEGORY: Exploratory Development

OBJECTIVE: To generate a computer model that can predict the acoustic signature of an internal combustion engine based on cylinder gas pressure, temperature, exhaust timing, and various exhaust path parameters. Furthermore, exhaust noise suppression prediction will be possible based on various muffler design and active noise suppression parameters.

DESCRIPTION: Military systems powered by internal combustion engines produce complex acoustic signatures that are dependant on a great many engine, exhaust configuration, and muffler design parameters. The research performed under this contract will culminate in the development of an exhaust noise prediction model will assist in the analysis and subsequent quieting of exhaust noise. Furthermore, algorithms will be developed allowing the prediction of suppression levels based on various muffler configurations and designs. Such a model would be invaluable to the analyst and designer interested in acoustic noise suppression for stealth operation.

Phase I: The contractor(s) would instrument an internal combustion engine, mounted on a dynamometer, to collect various engine, exhaust and mechanical data for subsequent reduction, analysis and algorithm development. Moreover, theoretical models will be developed and utilize where appropriate. All algorithms will be validated by the test data.

Phase II: The contractor(s) would further develop and validate system submodels and initiate development of the algorithms necessary to model the performance of typical muffler systems. The input and output signals, for various muffler systems of different size, shape and configuration, will be

collected, reduced and analyzed to generate and/or validate theoretical models previously developed.

A91-102 TITLE: Unmanned Ground Vehicle Subsystem Technology

CATEGORY: Exploratory Development

OBJECTIVE: To explore new and innovative subsystem concepts that could be incorporated on a unmanned ground vehicle to enhance its mobility and performance.

DESCRIPTION: The Army is interested in developing small, light, rugged unmanned ground vehicle systems that are versatile for a variety of missions and operational environments. This project seeks potential specialized technology that could be utilized by these systems. These vehicles could adapt subsystems unique from manned
vehicles. Examples could include new locomotion concepts such as fluid or electric drives, batteries, solar power, or fly wheels. The concepts should focus on improved performance such as extended range improved reliability, noise reduction, better stability, control or traction, etc.

Phase I: The contractor would identify the technology, and qualify the feasibility of the concept for this application. The phase I effort should define the concept drawings of what the final design would consist of and identify critical elements and how they could be utilized. A scale test or demonstration of the technology if applicable for government evaluation is also desired.

Phase II: The contractor will further develop, integrate and test the subsystem on a new or existing prototype UGV. This system will be used to explore the performance and applicability of the technology for unmanned systems. The contractor will deliver all hardware, design drawings, as well as a test report and a final program report.

A91-103 TITLE: Unmanned Ground Vehicle Power and Cooling Subsystems

CATEGORY: Exploratory Development

OBJECTIVE: Explore new and innovative design techniques of providing electrical power and proper operating environment to electronic subsystems integrated into unmanned ground vehicle systems.

DESCRIPTION: The U.S. Army and Marine Corps anticipate using unmanned ground vehicle systems to perform a variety of missions, some of which are reconnaissance, mine detection, communications relay, and target acquisition. An unmanned vehicle system consists of an unmanned mobile base platform (MBU) and a manned operator control unit (OCU), each of which contain a variety of electronic subsystems. These subsystems impose severe power and cooling requirements on both the MBU and OCU. Studies have indicated that a tradeoff involving operational capabilities is necessary because conventional systems cannot provide the needed power and cooling and remain within size and weight constraints. To improve upon this, more efficient and economical techniques of supplying electrical power and subsystem cooling must be identified. This is necessary because of the limited amount of power and space available.

Phase I: During the initial phase, the contractor will evaluate various MBU and OCU configurations to determine representative power and cooling requirements. The contractor will identify critical technologies and develop a range of feasible concepts which address these requirements. The contractor will document all work performed under Phase I in a final report and include research methods, technical work description and results, and concept drawings.

Phase II: During this phase, the contractor will fabricate and test a prototype of the leading concept based on Phase I results. The prototype will be tested with actual MBU and OCU subsystems to verify performance. The contractor will deliver the following items to the Government: prototype,

design drawings, test report, and final report.

A91-104 TITLE: High Temperature Military Diesel Engine Components

CATEGORY: Exploratory Development

OBJECTIVE: Novel insulative in-cylinder/hot section designs for such components as pistons, liners, rings, valves, valve guides and seals, head or head face and ports will be fabricated and demonstrated.

DESCRIPTION: In order to meet goals of advanced high temperature military diesel engines, advancements must be made in the area of insulated hot section components. Anticipated operating conditions for these engines are cylinder head loadings of 4 cycle brake mean effective pressures of 300 psia or higher and low specific heat rejection to coolant, 12 BTU/HP-min or lower. Reliable component designs able to survive under the high temperature conditions are imperative. Design goals of engines under development include life expectancy of 1000 hours.

Phase I: Component design concepts shall be proven from a feasibility standpoint. High temperature bench type testing may be accomplished to prove feasibility of concept.

Phase II: Concept shall be demonstrated in a high output single or multicylinder diesel engine. Testing shall be accomplished using NATO-400 hour test or other acceptable durability test procedures approved by the government.

A91-105 TITLE: Advanced Multi-Channel Digital Data Acquisition and Storage System

CATEGORY: Exploratory Development

OBJECTIVE: To develop a optical-disk based digital data acquisition and storage system. The system will provide for the collection of multi-sensor broad-band data that will be inserted into a digital data base and disseminated to those DOD, industry and academic organizations that are interested in the analysis and development of acoustic and seismic technologies.

DESCRIPTION: The system must be capable of meeting the following requirements:
1. Expandable to 50 channels
2. Interchannel phase coherence of less then 1 degree
3. Variable sampling rate (to a maximum of 50 KHz per channel)
4. 80 dB of dynamic range
5. Encoding, to a predefined data base format, and storage, on a single high-data-rate 12-inch optical disk, of 3 minutes of continuous temporal data (all channels) and a single channel of color video data. Some data may be buffered but must be down loaded within 1 minute of end-of-run.

Phase I: The contractor(s) would develop a concept based on the above requirements and further direction from USATACOM engineers. The concept will be tested on the laboratory and the results integrated into a report. The report will provide sufficient technical detail to allow the government to determine if the specification has been met.

Phase II: The contractor(s) would develop and test a breadboard prototype suitable for joint field testing by contractor and TACOM acoustic engineers. A test and final report will be deliverable under this effort.

A91-106 TITLE: Modular Armor Attachment Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Devise, design, and demonstration of advanced technology modular armor attachment concepts and techniques. Design of interchangeable modular armor attachment methods.

DESCRIPTION: Future combat vehicles will employ "Modular Armor" protection systems that can be changed to meet different threat levels. Advanced armor protection units will be mounted and dismounted from the basic vehicle structure as needed and for vehicle protection upgrades. A system of advanced attachment methods must be designed and developed. This project seeks innovative modular armor attachment concepts and methods for the mounting of armor protection units, designed to counter larger caliber tank fired projectiles and anti-tank missiles. These threats include large kinetic energy and chemical energy anti-tank projectiles, as well as large anti-tank guided and unguided missiles. The mounting and attachment hardware, as well as the rest of the vehicle structure, will have to survive the ballistic shock effects transmitted through the armor modules and their attachment system. The parts of the attachment system that directly attaches to the vehicle structure must not be damaged.

Phase I: Literature and technology survey; attachment and mounting requirements, analysis, threat impact analysis; concept design, analysis and evaluations.

Phase II: Concept components testing and demonstrations; application considerations; concept system design and development; breadboard construction and demonstrations

A91-107 TITLE: Variable Emessivity Material(s)

CATEGORY: Exploratory Development

OBJECTIVE: Reduce the Infrared (IR), Visible and Ultraviolet (UV) spectral contrast between ARMY ground vehicles and a desert environment.

DESCRIPTION: The increasing sophistication of threat guidance systems places increased demands on the stealth capabilities of ground vehicles. Up to now some degree of success in camouflage has been attained in the passive realm using various pigment/dielectric combinations in paints to achieve a limited amount of signature contrast reduction in the IR region. There are presently some investigations under way to use active means for contrast reduction such as light panels. With the advent of thin-film technology it would be of interest to know if there is at present a technical solution to the problem of a wide band variable emissivity material, or combination of materials, that would produce a significant reduction in the IR, visible, and UV signatures of ground ARMY vehicles.

Phase I: The contractor(s) would identify all potential passive signature contrast reduction material combinations.

Phase II: The contractor(s) would develop the theory/operation of the concept via a computer study then fabricate a workable prototype for field evaluation.

A91-108 TITLE: Fundamental Natural Language Components

CATEGORY: Exploratory Development

OBJECTIVE: To investigate, develop, and demonstrate a fundamental core of general-purpose natural language processing components, design for use with various natural language systems, to increase the practicality of natural language processing in DoD applications.

DESCRIPTION: Many DoD applications could be improved with the ability to process English language textual data, whether with a natural language interface (NLI) to a software system, by generation of English language explanations of exceptional conditions, or by interpretation of the language of messages for automatic indexing, retrieval, routing, and summarization. All of these

applications require similar underlying databases: A grammar of English, a dictionary of the basic vocabulary of English (the lexicon), and a knowledge base representation of the general world knowledge needed to process language in any domain. In addition, tools are required to develop and manipulate these databases.

Phase I: This project will begin initial development of a core natural language capability by designing a generalized data format for the grammar, lexicon, and knowledge base that would allow straightforward use with a variety of linguistic theories in various domains; it should also have the characteristic of simple conversion to other formats. The design of the components during this phase should focus on generalizability to both interpretation and generation of language. Tools will be designed and developed to build and manipulate the databases. Then preliminary versions of the grammar, the lexicon, and the knowledge base will be developed and tested for a sample application and domain.

Phase II: The prototype databases from Phase I will be expanded to useful size, testing them for completeness, accuracy, and generality with additional linguistic theories for actual DoD applications in realistic domains.

U.S. ARMY TEST AND EVALUATION COMMAND

A91-109 TITLE: Aeriel Cable Inspection Trolley

CATEGORY: Basic Research

OBJECTIVE: To develop a self-contained aerial cable inspection trolley that can evaluate the condition of a 16,000 foot, 2 inch diameter synthetic cable in 5-10 minutes.

DESCRIPTION: An Aerial Cable inspection trolley that can quickly evaluate the external and internal condition of a suspended synthetic cable is required. This trolley must be self propelled long a 16,000 foot two point suspended single cable. The trolley must evaluate and report the external and internal condition of a two inch diameter cable constructed of synthetic materials. A complete log of cable condition shall be recorded on the trolley and transmitted by telemetry to a control facility. Sections of questionable or degraded quality shall be identified, catalogued, and displayed, without requiring review of the entire log. The trolley shall inspect and evaluate the entire length of cable in 5 - 10 minutes. This trolley including propulsion, inspection, data evaluation, telemetry, control, and braking systems shall not exceed a weight of 2000 pounds. Suspension, propulsion, and braking on the cable and inspection of the cable shall not induce excessive wear or other degradation to the cable material.

Phase I: Conceptual design of an Aerial Cable Inspection Trolley. This effort should identify the technical approach for all subsystems and an initial layout for the trolley.

Phase II: Development of a final design for the trolley and all subsystems. Fabrication and test of an Aerial Cable Inspection Trolley.

A91-110 TITLE: Real-Time Trajectory Estimation Combining External/Internal Telemetry Measurements

CATEGORY: Exploratory Development

OBJECTIVE: Real-time estimation of trajectory and attitude of missiles and aircraft using information encoded both externally and internally to the object under test.

DESCRIPTION: The advent of inexpensive high speed computing makes it feasible to combine external

measurements from radars, velocimeters, image trackers, etc., with internally encoded telemetry information such as inertial navigation information, guidance commands, event times, etc., in the real-time estimation of the trajectories and attitude of missiles and aircraft under test. This task will develop the processing methodology to permit the use of these types of data for the real-time stimation of flight trajectory and attitude. A wide variety of different types of missile and aircraft must be treated. The techniques developed must be robust and easily adaptable to the testing of new types of vehicles, and user friendly. Hardware requirements, data, communications protocols, real-time-time display techniques, and architectures commensurate with the proposed methodology and expected processing loads need to be identified.

Phase I: Develop the system concept for real-time estimation of trajectory and attitude combining both external and internal measurements. Perform initial development of the required algorithms.

Phase II: Demonstrate the full function of the algorithms. Furnish final hardware design and prototype hardware system.

A91-111 TITLE: Real-Time Sensor Data Fusion

CATEGORY: Advanced Development

OBJECTIVE: To develop methodology for real-time sensor data fusion for recognition, acquisition and tracking of desired targets to provide improved metric tracking data.

DESCRIPTION: Multiple sensors are being developed and will be integrated on a single tracking mount to recognize, acquire and track submunitions dispensed from missiles. The sensors involved are (1) a millimeter wave (mmw) coherent radar, (2) a visible-light standard TV camera and (3) an 8-12 micron FLIR, co-located on a Kineto tracking mount. Data from these systems will be used to detect a target of interest in a cluttered multitarget environment. After selection and lock-on of the target, data from the sensors will be combined to produce an optimal track. Data-rates will vary from 60/s (the optical data) to 15 000/s (the MMW radar). Data from another tracking system (e.g., C-band strumentation radar) will be provided (at 20/s) as pointing data for the missile prior to ejection of the submunitions. The pointing data can be switched to the output of a mathematical model of the submunition trajectory at the expected time of ejection. The expected time of ejection will also be available. The mode of operation of the combined radar/optical system will be automatic, remotely-located and unattended. The ability of the combined system to discriminate the submunition from the missile body and other debris may depend on target characteristics such as velocity differences as observed in the doppler of the mmw radar. (This task will involve the use of classified information. Therefore, the proper security clearances should have been obtained prior to submission of the Phase I proposal.)

Phase I: Develop concept and basic methodology and define resources required.

Phase II: Develop prototype system and verify approach with real tracking data obtained at the U.S. Army White Sands Missile Range.

A91-112 TITLE: Line of Sight Verification

CATEGORY: Engineering Development

OBJECTIVE: The development of a line-of-sight verification system capable of handling multiple weapon system platforms and multiple targets simultaneously in aircraft armament tests. This will enable accurate determination that the weapon system sensors had a clear path.

DESCRIPTION: Accurate scoring of sophisticated aircraft target acquisition system (TAS) in a multiple platform/multiple target test scenario requires knowledge in near-real time as to whether a line of sight (intervisibility) exists between the platform and its intended target. At present no method or system exists which accurately and reliably provides this information while remaining invisible to the TAS so as to ensure noninterference with testing. The purpose of this project is to develop such a system.

Phase I: Would consist of conceptual design of a line-of-sight verification system which can handle multiple weapon system platforms and multiple targets simultaneously where accurate information on line-of-sight is able to be unambiguously determined, recorded and sent to a control operations center in real time. Key experiments demonstrating the concept feasibility, especially where new technology is involved, may be necessary.

Phase II: Would consist of design, fabrication, and test of field-capable prototypes enabling field demonstration of the line-of-sight verification system.

A91-113 TITLE: Inference Engine Test Methodology

CATEGORY: Exploratory Development

OBJECTIVE: This project will develop test suites to be used to derive a standard set of performance and correctness measures for inference engines for simple, rule-based expert systems, as applicable to any C3I or support system employing rule-based expert system technology.

DESCRIPTION: There are at present no measures for performance or correctness for inference engines; nor are there standards efforts directed at their development. A set of standard test case suites of demonstrated effectiveness will allow at least black-box level verification of features and establishment of performance boundaries. This effort will develop such a standard suite allowing testing of a variety of tools. Most of the commercially available development shells share similar rule syntax. Translation to a given shell language is often possible with a simple one-pass translation program. Some test suites can be automatically generated with minor modification of the text generation algorithms. This will preclude the necessity of case-by-case creation of test suites of protocols for many of the shared features; e.g., simple forward and backward chaining, pattern matching, math functions, etc.

Phase I: Requirements and example sub-sets of test case sets will be explored and proposed "standard test case suites" will be defined. These "test case suites" will be applied to at least two inference engines for which source code is available as a proof-of-concept and test of the standard suites as correct/complete. In each case a feature to be examined will be defined from the documentation and source data, possible common error conditions will be defined, one or more test case suites devised to detect such errors, and the test cases will be tested against code into which these errors have been introduced. An estimate of the magnitude of work for a fully operational tool to test inference engines against a suitable standard set of suites in an automated fashion is required for Phase I.

Phase II: The objective of this phase is to develop a working prototype of the automated inference engine test tool by expanding and refining the techniques and findings resulting from the Phase I effort. The testing tool must be applicable to embedded rule-based expert systems as well as stand-alone systems.

A91-114 TITLE: Knowledge Base Validation

CATEGORY: Exploratory Development

OBJECTIVE: Develop and implement a software tool to be used as a working model for representing and analyzing expert system knowledge bases independent of specific development tools and paradigms as well as the application domains of the expert systems represented.

DESCRIPTION: Development of a software tool to analyze expert system knowledge bases for completeness, correctness, and other software quality factors. This tool must be capable of representing both the actual knowledge structures of a variety of representations and the formal constraints imposed by differing representations. An estimate of the magnitude of effort for a fully operational tool and, an indication of the difficulty within the selected architecture of implementing additional representation paradigms will be one of the products of this efforts. While initial prototyping of the tool is acceptable in any suitable development environment, the ultimate target use of the tool indicates that the architecture selected be one that will allow straightforward migration to the Ada language for production version.

Phase I: This effort will be conducted to develop and implement a working model; a set of structures and techniques for representing and analyzing expert system knowledge bases independent of specific development tools and paradigms; the application domains of the expert systems represented; and assistance in assessing the reliability, maintainability, completeness, correctness, efficiency, and other software quality factors of such systems.

Phase II: The objective of this phase is to expand the software tool to additional knowledge representation models, define and enter the syntax of several development tools, and represent the knowledge bases of a number of existing expert systems. This process will allow refinement and extension of the software tool capabilities and give test personnel the opportunity to analyze and evaluate real knowledge bases in a common environment.

A91-115 TITLE: Unmanned Ground Vehicle (UGV) Indoor Tracking System

CATEGORY: Engineering Development

OBJECTIVE: Develop a indoor tracking system to measure the accuracy of the navigation systems on teleoperated unmanned ground vehicles. The prototype system developed in Phase II will be installed at a Robotics Test Facility.

DESCRIPTION: There currently exists a need to provide position location of a Unmanned Ground Vehicle (UGV). Position data is used to measure the accuracy of the UGV's onboard navigation system and to quantify the UGV's teleoperation performance. To date, a satisfactory commercially available system is not available that can provide real-time data (updated at 60 Hz) on the UGV's position in x,y coordinates with an accuracy of +2.5 centimeters.

Phase I: Look into developing a indoor tracking system to measure the accuracy of the navigation system on a teleoperated UGV. The system should plot the UGV's location on a color monitor and a plotter or color printer. The data will be stored on an IBM compatible 386 Personal Computer. The system should minimize hardware onboard the UGV. There cannot be a tether or hard-wire connection from the vehicle to the control station. Any onboard hardware should not exceed five pounds.

Phase II: Design, fabricate, and install the tracking system within a robotics testing facility which is 40 foot tall and is constructed of aluminum and steel, covering an area of 35,000 square feet.

A91-116 TITLE: Digital Enhancement and Video Storage of Real-Time Flash X-Rays

CATEGORY: Engineering Development

OBJECTIVE: To develop a digital x-ray system that can extract more data from x-ray images the than the traditional film based system with greater reliability. The Phase II effort shall provide a prototype system to be used in actual tests for comparison with standard film based flash x-ray techniques.

DESCRIPTION: The current method of extracting data from x-ray film, the manual ruler and eye method, is insufficient for obtaining precise, unequivocal physical damage measurements such as target momentum, transfer of energy, and center of mass. A digital system is desired where Video cameras (e.g., CCD cameras) would be used to capture the x-ray images instead of existing film cameras. From these real-time x-rays, measurements of target momentum, transfer of energy, and center of mass measurements, which cannot be obtained with film based techniques, would be acquired. These measurements would supplement the traditional measurements of mass, velocity, and breakup characterization of armor, projectile, or jet.

Phase I: Develop a design for a digital x-ray system for obtaining x-ray images by recording the visible image produced by the illuminescent screens with video cameras. The image would then be digitized, manipulated with image processing, analyzed, and stored via computer.

Phase II: Provide a prototype system to field test and compare to the currently used film based system.

BALLISTICS RESEARCH LABORATORY

A91-117 TITLE: Laser Ordnance Ignition Systems

CATEGORY: Exploratory Development

OBJECTIVE: Design and Demonstration of Laser-Based Ignition Systems for Propelling Charges in Large Caliber Guns.

DESCRIPTION: The design and demonstration of laser-based ignition systems for propelling charges in large caliber guns is required. The approach must address both of the following requirements. The first ignition concept requires the design and construction of all components necessary for the initiation of conventional primer and igniter materials with laser radiation through an optical fiber coupled to a gun breech. The system must survive multiple initiations, incorporate fail-safe features and demonstrate reliability. The second laser ignition concept requires the design and construction of all components necessary for the direct ignition of propelling charges without the aid of conventional primer and igniter materials. Consumable optical fiber networks embedded in a propellant bed should be considered. The technology required to couple laser energy to multicomponent charges through an interface must be addressed.

Phase I: An engineering feasibility study which includes detailed designs that address the aforementioned requirements will be performed. Delivery of prototype systems for test and evaluation at BRL is desirable.

Phase II: Fully operable laser-based ignition systems will be constructed and delivered to BRL for test and evaluation.

A91-118 TITLE: Investigation of Bulk Loaded Liquid Propellant Gun Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Conduct small and/or medium caliber ballistic investigations of mechanical concepts to control the Bulk Loaded Liquid Propellant Gun (BLPG) Interior Ballistic Process.

DESCRIPTION: Liquid propellant gun concepts have been investigated since the late 1940s. Current Army efforts are focused on the Regenerative Liquid Propellant Gun (RLPG) for potential application

in the Advanced Field Artillery System (AFAS). However, the BLPG, which is a less complex embodiment of the basic LP gun concept would be a more attractive candidate for small and medium caliber applications if the basic ballistic control problems were resolved. In addition to being less complex than the RLPG, the bulk loaded LP concepts offers the potential for reduced gun size and weight, higher rates of fire and increased gun performance for a given gun volume (even over conventional solid propellants). A variety of mechanical and hydrodynamic approaches for controlling the BLPG interior ballistic process have been proposed in the past. Liquid propellants offer the potential for reduced logistics burden, reduced cost and reduced combat vehicle vulnerability while increasing safety throughout the system. Successful development of a bulk loaded LP concept for small and medium caliber cannons could increase the overall logistic and cost benefits of fielding a liquid propellant system and could find application in infantry fighting vehicles, aircraft cannon, and vehicle secondary armament as well as small arms.

Phase I: Conduct assessment of mechanical and hydrodynamic approaches for controlling the bulk loaded LP gun ballistic process. Select promising concepts for experimental evaluation. Conduct test firing in small and or medium caliber fixtures to evaluate feasibility. Prepare final technical report on effort.

Phase II: Conduct thorough ballistic evaluation of promising concepts in small and/or medium caliber fixtures. Demonstrate control of the ballistic process by repeatably varying maximum pressure, pressure rise rate and duration of ballistic event. Demonstrate repeatability of ballistic process and muzzle velocity. Conduct preliminary engineering evaluation and provide concepts for weaponization.

A91-119 TITLE: Down Barrel Propellant Injection

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate both 25% increased performance over base line interior ballistic prediction and control of process.

DESCRIPTION: Increased performance is a major thrust of interior ballistics. Current approaches are limited to combustion in the chamber which limits the ballistic efficiency at high velocity. Releasing the chemical energy closer to the projectile is one approach for increasing performance. An alternative approach is based on the traveling charge concept. This approach has been extensively studied both in liquid and solid propellants; the results indicate that performance gains of 10 to 15% are possible. Limitations of this approach are the difficulties in igniting the propellant at the optimum time, requirements for modifying the projectile, and the parasitic mass required to confine the propellant. Down barrel injection avoids these limitations. This method had been considered earlier in bulk loaded liquid propellant gun programs, however analysis to support possible increased performance was not performed. Since the technology of ignition and combustion of liquid propellants has significantly advanced during the last decade, a re-examination of down barrel injection may be warranted.

Phase I: Demonstrate analytically that the desired performance increase of 25% is possible. Perform parametric sensitivity to determine the overall sensitivity of the process, with a focus on timing and energy release rate of the injected propellant. The result should be an analysis that identifies the conditions required for optimizing the interior ballistic performance. It is envisioned that a 2-D analysis would be required to describe the down barrel injection and flow processes. Volume of liquid, local gas generation rates at the injector, and the location for the release of energy should be identified.

Phase II: Demonstrate in 30-mm firings both a 25% increase in performance and control of the interior ballistics. It is envisioned that liquid propellant would be used for the down barrel injection. Technology gains of the last decade that would be utilized include studies on rapid energy release rates associated with various types of electrical ignition. Other modes of initiation should also be considered, such as laser ignition.

A91-120 TITLE: Inert Boundaries for Controlling the Interior Ballistics of Bulk Loaded Liquid Propellant Guns

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate control of the interior ballistics of small and medium caliber Bulk Loaded Liquid Propellant Guns.

DESCRIPTION: Lack of control of the interior ballistic process has been the major obstacle for developing the bulk loaded liquid propellant gun concept. One approach which may offer some merit would be the use of inert boundaries in the charge. The boundaries would define a web size similar to solid propellants. A second approach would be the use of a cellular structure in the chamber. The requirement would be to demonstrate the feasibility of the approach and to demonstrate that performance, both in velocity and repeatability, can be achieved in a bulk loaded liquid propellant gun which is comparable to solid propellant guns.

Phase I: Review concepts for identifying approaches which might apply to the above description. Interior ballistic codes, such IBHV2, would be used to define the required boundary size and to determine the conditions that would yield the desired performance. One approach for defining a boundary would be the use of imbiber beads, first developed by Dow Chemical Chemical with the purpose of absorbing relatively large quantities of oil. Liquid propellant absorption and closed chamber combustion tests would be used to identify the desired combustion rates, which would provide the basis for proceeding to Phase II.

Phase II: Test the inert boundaries in small and medium caliber guns. Demonstrate velocity and repeatability equivalent to solid propellant guns.

A91-121 TITLE: Acoustic Liner for Dampening Pressure Oscillations in Regenerative Liquid Propellant Guns

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate the elimination of pressure oscillations during the interior ballistics of a regenerative liquid propellant gun firing.

DESCRIPTION: Pressure oscillations occur in all regenerative liquid propellant guns 30-mm and larger. The oscillations may have a serious impact on sensitive projectiles and may increase heat transfer and erosion. Because of their potential seriousness, programs have been proposed for studying both methods for suppressiong the oscillations and approaches for studying their effect on the weapon system. One approach which has successfully eliminated all pressure oscillations, tested at Sandia National Laboratory in a vented vessel with propellant injected into the chamber, involved the use of a high pressure hydraulic hose. Although not practical for development for gun use, the liner does suggest an approach which might be effectively utilized for use in regenerative guns.

Phase I: Perform an analysis of the acoustical impedance match between the gun chamber and the wall. The result should be the determination of the properties of a material which would absorb pressure oscillations and which would be suitable for use in the high temperature and high pressure environment of regenerative guns. Mechanisms by which the pressure oscillations may possibly be eliminated include absorption and wave cancellation. The former is the likely mechanism for the elimination of the waves in the tests performed at Sandia National Laboratory. The latter has been successfully used in rocket motors by the use of quarter wave dampers and Helmholtz resonators. These rocket approaches, however, are not consider practical for regenerative guns. A laminated material, on the other hand, with appropriate impedance matches at the layered boundaries, might serve the same

purpose as a quarter wave damper. An alternate approach which might also be feasible would be the use a single material to absorb the waves.

Phase ii: Materials proposed from Phase I would be evaluated in 30-mm regenerative liquid propellant guns at the Ballistic Research Laboratory. The Phase II results would include an identification of the materials, design and fabrication of the liners. The desired results would be the complete elimination of the pressure oscillations.

A91-122 TITLE: Diagnostic Probe

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate operation of an optical probe for use in gun chambers.

DESCRIPTION: Optical probes in gun chambers require specialized windows which are generally unique to the specific investigation. By contrast, pressure probes are extensively used and, in some cases, are even standardized between different companies. The objective of this task would be to utilize the dimensions of existing high pressure probes now used gun in tests and to develop an optical probe which could be used in the same port as the pressure gage. Advances in propulsion technologies during the past decade, such as the regenerative liquid propellant gun, as well as an interest in understanding the basic combustion processes, including solid propellant guns, have all raised questions which could be effectively examined with the use of optical probes. It is anticipated that such a probe could be used for straightforward luminosity measurements, more advanced temperature measurements, and, using a "fish eye" lens, in high speed photographic use. The development of such a probe based on transmission of visible light would be acceptable; more desirable would be the development of both an infrared and a visible probe.

Phase I: Determine the dimensions and fabricate at least ten optical probes, which would likely be based on the use of optical fibers, for mounting in a high pressure gage port.

Phase II: The first group of ten prototype gages would be evaluated in a medium caliber gun at the Ballistic Research Laboratory. It is expected that the Phase II effort would involve an iterative process between design, fabrication and testing. The desired result from Phase II would be the successful operation of the probe for at least twenty firings without damage to the probe. Cleaning of the probe between firings would be expected.

ARMY RESEARCH OFFICE

A91-123 TITLE: Synthesis, Processing and Function of Complex Macromolecules in Biological Systems

CATEGORY: Basic Research

OBJECTIVE: Clarify how higher order biological structure is achieved, as a determinant of macromolecular function.

DESCRIPTION: Basic research is needed to further our understanding of the dynamic materials and structures supporting cellular function, and of their biosynthetic pathways. To be able to apply toward Army systems a number of recent advances gained in Neurosciences and Biotechnology, fundamental insight is required, at the molecular level, regarding their further processing and, in some cases, hierarchical structures. For example, understanding of how a protein folds, as the final step in the overall process of gene expression, is a formidable challenge; it requires a solution to the central

problem of deciphering how amino acid sequences encode three-dimensional information. The major hurdle for successful development of many Biotechnology and Neurosciences products is the efficient production of properly folded proteins. A solution tc the folding problem will provide rules that will be used in the future in these Army key emerging technologies to construct unique catalysts, sensors and charge-separation devices, novel biomaterials for structural and motor function, and advanced therapeutic agents.

Phase I: Identify, and partially characterize, best candidate system for detailed study and design of appropriate methodology for verification of rules governing higher order structure.

Phase II: Development and validation of methodology for rule verification in test system; implementation in overall process, from blueprint to final, functional product.

A91-124 TITLE: Remote Sensing of the Atmospheric Boundary Layer

CATEGORY: Basic Research

OBJECTIVE: Develop the capability to measure the spatial distribution and temporal resolution of wind velocity, temperature, or water vapor fields in a volume of the atmospheric boundary layer (approximately (5 km)^2 by 2 km deep) at a resolution of 30 to 50 m. The measurement should be repeatable in a short time period commensutate with the energy processes at the spatial observing scales.

DESCRIPTION: The scientific understanding of boundary layer turbulence and dispersion processes is ultimately based on measurements. Most measurements are reported for homogeneous, quasi-steady conditions measured from single towers, tethered balloons, or to a limited extent, radar or lidar profilers. These one-dimensional measurements and aircraft measurements are extended to a second space dimension using the temporal evolution and/or assuming homogeneous conditions. In fact, we seldom have any real indication of the spatial distribution of boundary layer processes or the scale of energy distributions that drive them. Measurement technology has not been able to make quantified measurements of boundary layer fields.

Significant progress in fundamental understanding of boundary layerdispersion should result from a capacity to measure and analyze the spatial and temporal distributions of velocity, temperature, and moisture at scales of tens of meters and tens of seconds. Some of the progress envisioned by such a capability could be realistic sub-grid scale parameterizations for numerical models; understanding of the predictability of atmospheric turbulence; improved flux parameterizations; objective predictors of spatial intermittency; and assessment of the role of terrain in the dispersion process.

Phase I: The goal of Phase I is to develop the conceptual design of the sensing system, conduct a detailed study of the limitations and resolution capabilities of that system, identify the technological barriers, and propose viable approaches to acheiving the measuement goals.

Phase II: The goal of this phase is to construct and demonstrate the system(s) developed in Phase I.

A91-125 TITLE: High Temperature Smart Sensors and Actuators

CATEGORY: Basic Research

OBJECTIVE: To find new concepts for smart sensors and actuators with improved high temperature performance capabilities and frequency response.

DESCRIPTION: The area of smart materials and structures has the potential to revolutionize materials science and provide nextgeneration materials having importance for both military and commercial applications. Smart materials and structures make use of the unique ability of materials to change

properties in response to different stimuli. Typically, electrorheological fluids, piezoelectric materials, and shape memory alloys respond to changes in electric currents, electric fields, and temperature respectively. The integration of these sensors and actuators with computational/control capabilities enables smart materials/structures to provide "intelligent" responses including adapting, self diagnosis, life prediction, and self repair. An important concern of smart materials and structures is the temperature limitation of the sensors and actuator materials. For example, shape memory materials composed of nickel-titanium alloys have practical phase transitions below a temperature of 200°C. In addition, a need exist to developthermal management control to improve the frequency response of shape memory alloys.

Phase I: The Phase I effort should identify new sensor and actuator materials properties. Preliminary characterization and testing should demonstrate high temperature operation capabilities.

Phase II: The Phase II effort should optimize the material composition and processing of prototype components. Extensive characterization will be carried out with integration of the smart materials/structures into a structural prototype that demonstrates viability of the system.

A91-126 TITLE: Beam Processing of Materials

CATEGORY: Basic Research

OBJECTIVE: To improve utilization of ion and laser beams for surface modification/characterization of materials

DESCRIPTION: Ion and Laser beams offer unique opportunities for environmentally acceptable surface treatments. Many uncertainties exist in terms of processing parameters and particular process applicability for specific product having improved corrosion and wear properties. Important concerns involve continuous rather than batch processing, quality control during processing, durability and life cycle cost of the finished product. Improved models and data are needed for characterization of process conditions including temperature profiles, compositional changes,
materials properties, (ie reflectivity as a function of temperature and laser frequency distribution), damage distribution as a function of beam energy and incident ion distribution, etc.

Phase I: The phase I effort should identify a materials component or product (bearing, sheet stock etc.) and provide research substantiating technical and cost data and models appropriate for evaluating the scale up potential to continuous processing.

Phase II: In phase II the contractor should carry out extensive characterization that relates process product to processing conditions with the objective being to remove empirical uncertainties from component or product manufacturing.

A91-127 TITLE: Non-Destructive Evaluation Technology

CATEGORY: Basic Research

OBJECTIVE: To provide new approaches/physical techniques for predicting the failure and/or remaining lifetime of polymers, fabrics and composite materials.

DESCRIPTION: Army equipment such as lightweight vehicles, high performance helicopters, composite gun tubes and chemical/biological suits and enclosures require periodic inspection and serviceability recertification. There is a need for new concepts and techniques that provide accurate assessments of remaining life as well as in-process non-destructive evaluation and feedback/control during the manufacturing of composite materials and fabrics. This could include new analytical capabilities for the detection of signatures of materials defects, contaminants, microstructural characteristics etc. New

innovative NDE concepts based upon thermal, particle, optical, and other phenomena are of especial interest.

Phase I: Preliminary experiments/characterization research will establishthe feasibility (technical/cost) of the new approach/technique.

Phase II: The phase II effort will carry out extensive characterization with a goal being the design of an optimized system for specific Army components. A prototype system will be built and tested.

A91-128 TITLE: Optical Techniques for the Control and Data Processing of Microwave and Millimeter Arrays

CATEGORY: Basic Research

OBJECTIVE: Elucidate, define and apply principles and techniques for improved performance of microwave and millimeter wave arrays with reduced cost through the use of optical signal distribution and data processing.

DESCRIPTION: Active microwave and millimeter wave arrays require distribution of signals over long distances in terms of the system wavelength with very precise control of amplitude and phase. This requirement leads to systems requiring tight dimensional tolerances and resulting high cost. Optical signals from one or more LASERS can be modulated and/or combined in a non-linear device to generate the microwave/millimeter-wave signal with the proper phase relationship required for each element of the array. These optical signals may be distributed to the array elements via single mode optical fibers. Processing of the received signal may also be processed in the optical domain through the application of wavefront processing techniques. Innovative techniques and approaches are needed to realize the potential of such architectures at low cost. Of special interest are innovations associated with optical micro-wave/millimeter-wave interfaces and in wavefront processing techniques.

Phase I: The goal of Phase I will be to establish the feasibility of signal distribution, control, and beam forming for phased arrays using optical techniques for both transmission and reception.

Phase II: The goal of Phase II will be to demonstrate, in hardware, optical techniques for phased array systems and to demonstrate the viability of optical wavefront processing for reception.

A91-129 TITLE: Robust and Adaptive Control for Multivariable and Nonlinear Systems

CATEGORY: Basic and Applied Research

OBJECTIVE: Develop feedback control techniques in the presence of uncertainties with emphasis on development, analysis, design and implementation of real-time control procedures. Specific emphasis is on robust and adaptive control procedures.

DESCRIPTION: It is generally impossible to describe the dynamics of most real systems such as fire control systems, flexible robotic structures, rotorcrafts, and guidance systems by precise mathematical models. System engineers always encounter modeling uncertainties and unmeasurable external perturbations. Robust and adaptive control procedures have proved to be extremely promising approaches to accomplish overall system objectives. Furthermore, continuing progress in high performance computing environments offers new opportunities for both efficient off-line simulation and analysis and real-time implementation of these procedures in real systems.

Phase I: Develop and analyze robust and adaptive control strategies for multivariable systems, systems with delays, and more generally for nonlinear systems. Develop fast and reliable numerical procedures that can be implemented efficiently on multiprocessor architectures or embedded systems.

Phase II: Design and implement real-time control strategies in prototype systems.

ATMOSPHERIC SCIENCE LABORATORY

A91-130 TITLE: Mesoscale Saltation of Sand-Sized Particles in Turbulent Environments

CATEGORY: Exploratory Development

OBJECTIVE: Development of an algorithm or methodology to accurately predict the unit integrated concentrations of windborne sand and dust.

DESCRIPTION: Blowing sand and dust during periods of high winds reduce visibility and act as an obscurant adversely affecting the performance of multi-spectral target acquisition systems. A requirement exist for a model to prognosticate the extinction and obscuration that will occur over a mesoscale area for the visible through the far infrared wavelengths plus the millimeter bands of the electromagnetic spectrum.

Phase I: Develop a saltation and turbulent transport area source algorithm for the purpose of estimating integrated concentrations with respect to a spherical coordinate system. The model should be capable of estimating integrated concentrations over observer to target path lengths for all reasonable azimuth and zenith angles. Transmittances and extinction should be considered for the visible, near infrared, mid infrared, far infrared, and millimeter wavelengths. Phase II: Evaluation and testing of the prototype code using available experimental data and real time experimental data and real time verification in actual field tests.

A91-131 TITLE: Acoustic Scattering by a Vortex Model of Turbulence

CATEGORY: Exploratory Development

OBJECTIVE: Develop a mathematical methodology and a computer model that predict acoustic signal levels at locations remote from a turbulence region which is modeled by randomly oriented and positioned vortices.

DESCRIPTION: Current models for acoustic scattering from turbulence begin by postulating a random phase distribution in the scattered field. The statistical parameters of this distribution are usually specified with no formal relation-ship to the physical distribution of the atmospheric mass within the turbulence region. Current research is under-taking the task of specifying how acoustic waves are scattered from individual vortices and the task of specify-ing a size and number distribution of vortices that will match measured turbulence characteristics.

Phase I: Develop a mathematical methodology that determines the phase of the scattered acoustic field from a vortex based turbulence model. This methodology will be more realistic and accurate than the present method because details of the turbulence density/velocity distribution will be taken into account. The findings of the two research tasks referred to above will provide the basic ingredients from which the contractor can build the methodology.

Phase II: Develop a computer model of the mathematical methodology developed under Phase I. Evaluate the new model by comparison with results of current models and with field data.

A91-132 TITLE: Water Vapor Effects Upon the Thermodynamic Function of State

CATEGORY: Exploratory Development

OBJECTIVE: Investigation of the impact of specific humidity and evapotranspiration upon the vertical temperature distribution or gradients over rough, natural terrain.

DESCRIPTION: Consideration of water vapor in energy balance models qualifies specific humidities and evapotranspiration as thermodynamic functions of state of the atmospheres. A requirement exists for the investigation of the effects of humidity and evapotranspiration on atmospheric temperature and associated vertical gradients. Solutions and applica-tions of energy and radiation balance models are compounded by a varying soil moisture content that is a function of precipitation amounts on snow melt. Desiccation of soil moisture will, in turn, be a function of soil type and vegetation. Other factors that must be considered include atmospheric stability, cloud cover, time of day, and season of the year.

Phase I: Develop a hypothesis and an algorithm that relates water vapor content of the atmosphere to evapotranspirative processes, soil moisture content, and atmospheric stability during diabatic conditions.

Phase II: Evaluation and testing of the prototype code using available experimental data and the design and conduct of a verification field experiment based upon the preliminary results.

ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY

A91-133 TITLE: Room Temperature IR Detector Sensitive in the 8-12f Wavelength Region

CATEGORY: Exploratory Development

OBJECTIVE: Develop and produce high performance far IR detectors that operate at room temperature.

DESCRIPTION: High detectivity II-VI far IR detectors have existed for over a decade. However, these detectors are not suitable for all applications because they require cooling to cryogenic temperatures. Novel technology which allows the demonstration of high performance far IR detectors which operate at room temperature is sought.

Phase I: Demonstrate proof of concept by fabrication and characterization of several devices described in the submitted proposal. These devices will also be characterized by the technical staff at ETDL, Ft. Monmouth, NJ.

Phase II: Develop the technology necessary to produce focal plane arrays of the demonstrated devices, and produce 256x256 arrays of devices for characterization at CNVEO, Ft. Belvoir, VA.

A91-134 TITLE: Passive Millimeter Wave Imaging

CATEGORY: Advanced Development

OBJECTIVE: Develop passive millimeterwave imaging technology for current surveillance, navigation, landing, and missile guidance.

DESCRIPTION: Current millimeter wave target recognition, navigation, surveillance and guidance is based on active radar technology which is susceptible to poor performance due to clutter during its acquisition phase, as well as its lack of covertness and potential jamming countermeasures. Passive millimeter wave system using staring focal plane array technology should be evaluated to determine is

applicability to solving these passive imaging applications.

Phase I: Will study the tradeoffs possible between scenario, contrast, brightness, and temperature requirements at 35, 94 and 140 GHz, the immunity to jamming sources, the vehicle imposed hardware size restraints and the design of the focal plane array. Laboratory tests will be performed to validate the concept.

Phase II: Will develop the focal plane array. The array will be tested in the laboratory for final design and build.

A91-135 TITLE: Chip on Glass for Flat Panel Displays

CATEGORY: Exploratory Development

OBJECTIVE: Develop chip on glass technology to reduce the number of required interconnects to drive flat panel displays.

DESCRIPTION: Recent advances in flat panel display technology have shown that the panel technology is capable of high resolutions and high line numbers. One area of concern is the connection of external drivers to the display panels. This can require thousands of connections to the panel. To reduce the number of connections to the display panel a method for placing the drive chips on the perimeter of the display panel is required.

Phase I: Phase one of the program should identify the technology to be used. It should develop the processes sufficiently so that working prototypes utilizing the developed technology could be built and tested for functionality and reliability.

Phase II: Phase two of the program would incorporate the technology developed in phase one into displays and display heads that would demonstrate the technology in useful devices for Army needs and systems.

A91-136 TITLE: High Energy Density Dielectric Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop technology for high energy/high power density discharge capacitors utilizing novel materials with high dielectric constant, high dielectric strength, and low dissipation factor.

DESCRIPTION: Some future Army missions will require capacitors for high energy pulse power applications. The goal is a capacitor bank with a nominal rating of 10,000 volts an energy density in the range of tens of kJ/kg, and a capacity of in the multi-magajoule range. To achieve this goal, novel materials with properties aforementioned in the objective are required. The materials will include but not limited to the following two categories: 1) Solid dielectric films of polymeric, inorganic or composite nature. The ideal films should possess dielectric constants greater than 10; high dielectric strength; high insulation resistance; and low dissipation factors over a wide range of temperatures and frequencies; 2) Liquid dielectrics of organic, inorganic or polymeric nature. These liquids could be used as impregnants in capacitors to increase the maximum voltage of existing or new high energy dielectric films. Liquids with higher dielectric constants are our goal.

Phase I: Phase I should result in one or more candidate high energy dielectric films and compatible impregnants. Validity of the candidate materials should be demonstrated through preliminary dielectric tests including measurements of dielectric constant, dissipation factor, and dielectric strength.

Phase II: At least one of the polymer film/impregnant candidates should be explored further through structure modification, purification or processing. The dielectric properties of the candidate materials should be evaluated. As a desirable option, metallization techniques will be developed and

prototype laboratory-size capacitors containing candidate materials will be constructed and evaluated.

A91-137 TITLE: Arsine and/or Phosphine Substitutes for Organometallic Vapor Phase Epitaxy (OMVPE)

CATEGORY: Exploratory Development

OBJECTIVE: Develop chemicals that are less hazardous than arsine and/or phosphine that can be used to grow III-V semiconductor films of high purity using the OMVPE growth technique.

DESCRIPTION: The OMVPE growth technique is attractive because it can be used to grow high purity, thin layer device structures with abrupt interfaces. Moreover, it has significant cost throughput advantages over the competing molecular beam epitaxy (MBE) growth technology, and it can more readily be used to grow phosphorous based compounds. However, both arsine and phosphine are highly toxic gases that must be stored under high pressure to insure an adequate supply. The costs of providing a safe working environment would be reduced significantly if less toxic, high vapor pressure liquids could be found that could be used to grow semiconductor films of comparable quality.

Phase I: Identify and produce novel chemicals that can possibly be used as arsine and/or phosphine substitutes. They should preferably be a high vapor pressure liquid - > 5 torr at room temperature, have a low toxicity, be stable at room temperature, and be able to be manufactured in a very pure form. Also, demonstrate that semiconductor films of reasonable quality can be grown using them.

Phase II: Determine the conditions under which the best quality films can be grown. Grow a number of device structures and characterize the material chemically, electrically, and optically.

A91-138 TITLE: SAW Fourier Transform Subsystem with Digital Correction

CATEGORY: Advanced Development

OBJECTIVE: Design, develop and demonstrate a high performance, surface acoustic wave (SAW), Chirp-Fourier-Transform (CFT) subsystem that employs digital error-correction to achieve both high frequency resolution and high dynamic range.

DESCRIPTION: Compact, low-power, moderately wideband Fourier transform processors that operate in near-real-time are required for advanced communication intelligence (COMINT) receiver applications. These processors must provide both high frequency resolution (i.e. 15K Hz) and high dynamic range (60 dB as determined by the close-in time sidelobe level). The proposed program would exploit a hybrid technology approach to address this need, whereby the high speed of SAW analog processing would be combined with high accuracy digital processing. Digital correction of the SAW device amplitude and phase errors, which would result in substantially reduced time sidelobe levels for the CFT output, should be realized using simple, low-speed digital circuits.

Phase I: This phase would study and model a CFT subsystem with a bandwidth of 60 MHz and an analysis time of 60 microseconds; the CFT would use a convolve-multiple-convolve configuration. A simple proof-of-principle demonstration would be performed via computer simulation. Phase I would result in a detailed technical report which includes plans for Phase II, as well.

Phase II: This phase would design, construct and demonstrate a complete high-performance, SAW-based CFT subsystem. The CFT processor would utilize simple low-speed digital circuits such as 5 MHz CMOS PROM's along with low-cost, uncompensated SAW devices. The program would produce and deliver a digitally-corrected processor with time sidelobes levels near 60 dB along with a Final Report.

A91-139 TITLE: Autostereoscopic Video Displays

CATEGORY: Exploratory Development

OBJECTIVE: Identify, develop and demonstrate single sensor stereo camera or autostereoscopic display techniques potentially applicable to flat panel autos-tereoscopic displays.

DESCRIPTION: Recent developments in single video camera sensor and autostereoscopic display technology (achieving a stereoscopic display without the required optical supporting glasses or other optical devices) indicate this technology has the potential of being applied to flat panel displays. This effort seeks to assess and study the applicability and implementation of sensor and autostereoscopic techniques for use with flat panel displays. The dynamic nature of stereoscopic display technology makes it difficult to assess the current status of progress to date that is potentially applicable to flat panel displays.

Phase I: An analysis of one or more approaches to single camera stereo sensors or autostereoscopic technology and identifying specific techniques with potential application to video displays. Simple proof-of-concept demonstrations of these techniques is a requirement and may take the form of static displays. However, translation of the demonstrated approach must be reasonably shown to be translatable to video and to video flat panel displays. Selection of prototype demos will be made and approaches will be determined as satisfying objectives that are representatives of Army tactical situations.

Phase II: Demonstrations of sensor and/or autostereoscopic approaches representing capability against proposed wide range of needs will be completed and the approaches documented for further refinement and development. The end products should be capable of demonstration with state-of-the-art devices, video camera and flat panel displays. Approaches should be documented towards several Army needs and how the application of these techniques will be applied to Army systems.

A91-140 TITLE: Flux Pump for Charging Superconductive Inductance Tpe Energy Storage Systems

CATEGORY: Exploratory Development

OBJECTIVE: Identify, study and develop a practical and efficient approach to store/remove energy in a superconducting coil for the development of a notional power source for Army 21 C3I systems.

DESCRIPTION: Recent discoveries in high Tc superconducting materials have opened the way for developing new, unique technology for power sources for the future Army 21 Concept. Long-life, energy-conserving power sources are envisioned to cost effectively replace expensive, throwaway lithium batteries for operating C3I systems in dynamic Army 21 battle scenarios. Notional Superconducting Magnetic Energy Power Sources (SMEPS) are based on the novel concept of storing large amounts of energy in the magnetic field of a superconducting inductive coil. The high energy coil, in conjunction with appropriate energy conversion and electronic power conditioning circuitry, produces a stable power supply. Electrical output characteristics are compatible with C3I user equipment normally powered by electrochemical batteries.

Phase I: The purpose of Phase I investigation is to develop design concepts for a flux pump for charging superconducting coils to high circulating current levels. The total energy in a charged coil being proportional to the inductance of the coil and the magnitude of the circulating current, high energy storage (K joules) in a small coil requires high current levels (K amps). Production of high current levels from power/current limited military power sources requires amplification of the current

capacity of the power source. A flux pump is a conceptual device that can achieve current amplification by inserting incremental flux pulses into the total flux in a coil in a periodic manner. In recent years, several schemes have been advanced by means of which flux may be introduced into a closed superconducting loop. Such developments have made flux pumping, that is, the accumulation of flux by its addition in increments, possible.

Phase II: Characteristics of the flux design concepts identified in Phasel will be analyzed to determine feasibility and compatibility with the requirements of high energy coil designs being investigated for Superconducting Magnetic Energy Power Sources for military use. The study will include analysis of the physical and electrical characteristics and performance capabilities of superconducting switches which are basic components of flux pumping systems. Design concepts will be synthesized for a practical flux pump for SMEPS systems. Successful development will permit SMEPS operation in the dynamic combat environment envisioned for future Army 21 operations.

A91-141 TITLE: Modeling of Electron Cyclotron Resonance (ECR) Plasma Process for Etching of III-V Compound Materials

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate a mathematical model for describing electron cyclotron resonance (ECR) plasma Etching technique as it applies to the etching of III-V compound materials.

DESCRIPTION: The growing trend toward semiconductor devices with ever smaller submicron feature sizes requires a new generation of plasma etching technology. One new technique which shows promise for providing features as small as 0.2 micrometers is the ECR process. This process operates under pressures ($\sim$10-4 torr) which are an order of magnitude lower than even the magnetron ion etching (MIE) process; this allows for the etching of very small features because the lower pressure helps the reacted gas to escape from, and the new etch gas to get into, the very narrow etched wells. Other benefits of ECR plasma etching are a high degree of anisotropy, high selectivity, high etching rates, and low damage because of the low incident ion energy.

Phase I: Initiate the formulation of a mathematical model to describe the ECR plasma etching technique applied to the etching of III-V compound materials. Demonstrate the reasonableness of the model by performing preliminary calculations of a basic plasma etching quantity such as etch rate.

Phase II: Fully develop a model to describe the ECR plasma etching technique for etching III-V materials, taking into account all the relevant system parameters such as etching gas pressure, flow rate, excitation power, system geometry, etc. Perform experiments on a specific ECR system for the purpose of verifying the feasibility of the model which has been developed.

A91-142 Title: High Peak Power/High Performance Power Combiner

CATEGORY: Advanced and Exploratory Development

OBJECTIVE: Design and develop power combiner components for sub-nanosecond risetime nanoseconds pulses with tens of megawatts peak power at high pulse repetion frequency (PRF). Performance goals include minimum 90% voltage combination efficiency with PRF capability up to 1 kHz, while maintaining sub-nanosecond risetime property.

DESCRIPTION: The simultaneous operation of multiple arrays of the optically triggered hybrid or integrated pulsers, in which the generation of sub-nanosecond risetime pulses with tens of megawatts peak power at high PRF is expected, could result in giga-watt ultra-narrow RF source. The power

combiners combine pulses from array of fifteen or more pulsers into a single sub-nanosecond risetime pulse with giga-watt peak power. A critical technological barrier is in the area of the power combiner technology, in which an extensive development effort is needed.

Phase I: Conduct investigation on the power combining methodology for the sub-nanosecond risetime nanosecond pulses with tens of megawatts peak power, select the best approach, and determine the optimum design for the individual power combiner. Demonstrate the functionality of this combiner at 20 megawatts peak power.

Phase II: Demonstrate sub-system level performance. Combiners will be integrated into the multiple arrays of solid state based RF source, assessed their functionalities at system level, and demonstrated system level performance up to
giga-watts peak power at 1 kHz PRF.

A91-143 TITLE: Reduction of Dislocations in Quartz Crystals

CATEGORY: Exploratory Development

OBJECTIVE: Develop methods for reducing dislocations in quartz.

DESCRIPTION: Dislocations in quartz affect the fabrication and use of quartz resonators in several unwanted ways. Chemical polishing is a common procedure in the manufacture of quartz resonators, however, its use is limited by the channels formed when the dislocations are selectively etched. These etch channels reduce the Q, the yields during fabrication, and can lower the mechanical strength of the finished blanks. Sweeping (electrodiffusion) removes the atoms that decorate the dislocations and reduces the number of etch channels formed during processing, but it does not remove the dislocations. The effects of dislocations on resonator performance are less obvious than the effects of etch channels. The requirements on resonator specifications have tightened over the years. Research on the acceleration sensitivity of quartz
resonators has shown that the placement of the vibrational modes is critical and that the mode shape and position can be distorted by the presence of dislocations. In other resonator instabilities (like hysteresis and aging), circumstantial evidence is increasingly pointing toward defects, such as dislocations, as being important contributing factors. Past efforts at reducing etch channel density have attempted to grow quartz in silver lined vessels and to slow the growth rate. These have had limited success. This program is intended to explore new and innovative approaches to significantly reduce the dislocation density in quartz.

Phase I: Phase I will explore new methods for producing low dislocation density quartz. Methods that are capable of resulting in low dislocation density quartz plates are of special interest.

Phase II: Phase II will consolidate the techniques developed in Phase I. Laboratory scale equipment may be bought or built to generate low dislocation quartz suitable for resonator fabrication.

A91-144 TITLE: Microcircuit Three-Dimensional Packaging

CATEGORY: Exploratory Development

OBJECTIVE: Study and investigate high-density three-dimensional (3-D) packaging and interconnection schemes for
multichip module application.

DESCRIPTION: A new 3-D packaging approach is needed for future DoD electronic systems in order to reduce size and weight and to improve electrical and thermal performance of Very Large Scale Integration (VLSI), Application Specific Integrated Circuit (ASIC), and Very High Speed Integrated

Circuit (VHSIC) multichip modules. Size and speed requirements require advance of microcircuit packaging to progress from individual chip packages to multi-chip 3-D packaging. The resulting multichip module 3-D technology must be capable of meeting military environmental requirements as well as high speed electrical and high power thermal characteristics. Future modules of this type will be utilized for VLSI, ASIC and VHSIC chips applied to DoD electronic systems.

Phase I: Phase I should result in a technical report covering a study and investigation of new advanced high density 3-D packaging and interconnection schemes for use in multichip modules. Emphasis should be placed on use of hybrid wafer scale integration and three-dimensional assembly techniques to result in reliable 3-D packaging for military electronics.

Phase II: Phase II should result in experimental 3-D packaging and interconnection techniques, and demonstration circuitry to show proof of principle for the multichip module. Testing and evaluation of the high density packaging scheme should be included.

A91-145 TITLE: Rechargeable Lithium Battery with Solid Electrolyte

CATEGORY: Exploratory Development

OBJECTIVE:

DESCRIPTION: The Army requires rechargeable lithium batteries to power manportable circuits for communications, target acquisition, sensors and similar applications. Typical battery requirements are as follows:
Weight: <1kg
Operating Voltage: 20 Volts
Current: > 2 amps
Cycle Life: >50
Charge Retention: >1 month at 71oC
Operating Temperature Range: -34 to 71oC
Battery Capacity: >7 amp-hours
Past efforts to meet the above requirements have focussed on the development of battery chemistries utilizing electrolytes
formulated with organic and covalent inorganic solvents. Some of the difficulties which have been encountered include the achievement of high discharge currents (20 amps is a long-term goal) low temperature operation and good charge retention. Solid electrolytes (e.g., gels, polymers) are seen as an alternative to liquid electrolytes since such electrolytes would allow bipolar battery construction, close placement of electrodes and retardation of undesirable chemical reactions. Such features would have a favorable impact on the battery performance problems mentioned alone. What is desired in this program is the development or identification of candidate solid electrolytes, compatible positive plate materials, compatible lithium or lithium-like negative plates and the construction and demonstration of prototype cells and batteries.

Phase I: Synthesis/identification of at least one candidate solid electrolyte. Candidate(s) should be shown to possess good conductivity over a wide temperature range, and compatibility with lithium and at least one positive plate material.

Phase II: This phase provides for further exploration and refinement of electrolytes and compatible electrochemical couples, seeking the highest possible combination of energy and power density, long cycle life, good charge retention and all-temperature operation. Electrode and cell fabrication techniques will be developed and refined. Prototype cells and/or bipolar battery modules will be developed and demonstrated. The latter may be of relatively low capacity but capable of scale-up to a full-size battery.

A91-146 TITLE: High Frequency Optical External Modulator

CATEGORY: Exploratory Development

OBJECTIVE: Identify, develop and document the design and fabrication of a high frequency optical external modulator which can be modulated into the millimeter wave region.

DESCRIPTION: Presently direct modulation of semiconductor lasers is limited to 10 GHz at the 850 nm region and to 15 GHz at a wavelength of 1.3 um. The need to generate higher frequency microwave signals and millimeter wave signals for electronic warfare, millimeter wave radar and extremely high frequency satellite communications requires external modulators.

Phase I: Investigate optical external modulator designs which can be modulated beyond 20 GHz. Present fabrication techniques, design tradeoffs and external matching techniques for improved return loss and improved signal transmission. Designs should be presented at 850 nm and 1.3 um.

Phase II: Fabricate and characterize the devices for transmission loss bandwidth, maximum power. Improve design where needed.

A91-147 TITLE: Low Cost Dual-Mode Sensor Technology

CATEGORY: Engineering Development

OBJECTIVE: To investigate low cost millimeter wave/infrared dual-mode sensor technology including signal processing technique for tactical weapons applications.

DESCRIPTION: Dual-mode sensor with coincident millimeter wave and infrared target and clutter signal processing has much enhanced target discrimination/identification, clutter rejection and counter-countermeasure capabilities. However, it is important that high performance millimeter wave integrated circuits and infrared detectors and their combined driver and signal processing electronics must also be efficient and low cost based on innovative circuit concepts and large scale circuit integration technology.

Phase I: Innovative circuit concept on millimeter wave integrated circuits and infrared detector technology are to be explored for low cost small-size dual-mode sensor with driver and integrated sensor and infrared detector such as quantum-well devices fabrication/electronic circuit processing will be emphasized.

Phase II: Dual-mode sensor will be fabricated based on Phase I results to demonstrate the low cost, small size and integrated circuit front end technology and related signal processing technique. The dual-mode sensors are expected to have major applications in the area of smart munition, fire control, air defense, missile seeker and other tactical weapons applications.

HUMAN ENGINEERING LABORATORY

A91-148 TITLE: User Interface Management System Tools for Army Planning Applications

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to develop and integrate a set of User Interface Management System (UIMS) tools, built upon the X-Window/Motif interaction toolkits which can provide all or part of the following functions:

1) Interactive Design Tool - providing direct manipulation graphical layout and interaction specification (dialogue) design (capable of being used by a non-programmer) and generation of efficient User Interface Language (UIL) code.
2) User Interface Manager - based on the Seeheim user interface architecture (application/dialogue/presentation layers), this tool would arbitrate between the user and the application at runtime.
3) User Interface Evaluation Tool - providing facilities for logging user interactions for protocol analysis.

4) Intelligent Presentation Manager - capable of assembling a suitable set of presentation objects (based on Motif widget set) in response to an information presentation requirement.
5) Interaction Objects Generation Tools - for example, callback editor, widget construction tools, icon editor, interactive graphics package, map/drawing/image editor/integrator.
6) Style checkers - to provide feedback on adherence to or enforcement of style/usability guidelines.

DESCRIPTION: Direct manipulation Graphical User Interfaces (GUI) are becoming more commonplace in the Army as the industry standard X-window system and Motif "look & feel" and intrinsics-based toolkit are being adopted as the preferred common environment for future Army software development. There is a need to provide improved tools to support design, implementation (including rapid prototyping), management (at runtime), maintenance and evaluation of the GUI of applications being developed by the Army. Collectively, these tools have become known as User Interface Management Systems (UIMS's). An UIMS can free the application programmer from low level implementation details so as to be able to iteratively produce and refine higher quality, better human-engineered GUI's.

The Motif-based GUI's developed by HEL for applications in tactical logistics planning and scheduling will provide the user interface definition. These applications require innovative approaches to the presentation of tactical planning information that has both a spatial and temporal dimension. The UIMS should include support for multimedia interfaces, particularly the use of graphical animation techniques and transparent color overlays. The proposed development should be fully compatible with UNIX, the X Window System and Motif standards, and should incorporate, as appropriate, the interchange format standards as they are promulgated by the Open Software Foundation UIMS and IEEE P1201 working groups.

Phase I: This work should adapt or extend, to the maximum extent possible, commercially marketed or public domain GUI building tools. Phase I should include a serious effort at prototype implementation on a UNIX (Sun Sparc compatible) workstation (bidders must have their own computing facility). Technical specification of the Application Program Interface (API) for HEL's logistics planning applications will be provided by the Government at the start of Phase I.

Phase II: Phase II should emphasize the full development and evaluation of an operational prototype capable of producing some portion of a GUI for HEL's tactical logistics planning applications.

A91-149 TITLE: Global Positioning System Fuze Oscillator Design

CATEGORY: Exploratory Development

OBJECTIVE: Develop a low cost, compact, stable oscillator that will meet the requirements of Global Positioning Systems (GPS) Fuze.

DESCRIPTION: The fire support community of the U.S. has defined a need to precisely locate projectiles in flight for use in both operational and testing environments. One way of collecting this information is to equip these projectiles with a fuze that receives GPS location information and transmits it to a ground station in near-real time. While it appears that a GPS receiver/translator can be

miniaturized to meet the size and weight requirements, the performance requirements of several subcomponents, such as the oscillator, have not been defined. The oscillator is a key element in the GPS Frequency Translator for the artillery fuze. The performance characteristics of the oscillator contributes to and determines the reaction time, sets threshold receiver performance and limits navigational accuracy.

Phase I: The Phase I program for the GPS Fuze Oscillator shall establish performance requirements for the translator oscillator based upon the required system accuracy goals. These requirements shall include frequency accuracy, settling time, hysteresis, phase noise, G-sensitivity, environmental and survivability requirements. The other design drivers will be size, power and cost. The final output of Phase I shall be a report defining the feasibility of achieving requirements and suggested alternative solutions where requirements are unachievable.

Phase II: The Phase II program shall be directed toward fabricating operating prototypes of the oscillator system to be used in "brassboard" GPS fuzes during system testing.

A91-150 TITLE: Human Performance Issues in Automatic Target Recognition

CATEGORY: Exploratory Development

OBJECTIVE: To experimentally investigate variables affecting human performance of target acquisition tasks with aided target recognition systems.

DESCRIPTION: For the foreseeable future Automatic Target recognition Systems (ATR's) will include a man-in-the-decision-making-loop. The man-machine interface thus becomes a critical factor in determining how the system will perform. This program is aimed at investigating display parameters and human behaviors that impact system performance.

Phase I: Conduct preliminary experiments on target acquisition (recognition, identification detection, etc.) exploring variables such as (but not limited to) false alarm and miss rates, target priority, threat, cognitive load, etc.

Phase II: Pursue advanced experimental investigations of the parameters deemed to be the most important (i.e. having the most impact on system performance), with an eye towards generating man-machine interface system design recommendations for ATR systems.

A91-151 TITLE: The Human Factor in Information Displays in Combat Helicopters of the Future

CATEGORY: Exploratory Development

OBJECTIVE: To investigate man-machine interface problems stemming from the projected use of Situation Awareness displays in combat helicopters of the future.

DESCRIPTION: The modern battlefield has become a proving ground for high technology and Army aviation is no exception. Design engineers are faced with requirements to lighten the load, reduce crew size, deliver more firepower, and fight air-to-air battles. To accomplish these goals the helicopter cockpit of the future must be highly computerized and must allow for the presentation of large quantities of information. The pilot may be required to absorb and utilize this information while simultaneously piloting the aircraft. The Human Factor (i.e. matching the capabilities and limitations of the human to the presentation of that information) must be considered. The long range goals of this research program are to enhance target acquisition performance, and at the same time limit degradation of piloting performance stemming from possible operator overload.

Phase I: To identify relevant variables such as target density (i.e clutter), target numerosity,

mode of presentation (i.e. visual vs auditory), symbology, etc on target acquisition and piloting performance, and to design preliminary experiments.

Phase II: Conduct major experiments in a simulator on parameters identified in Phase I, with the goal of optimizing target acquisition performance in a manner least disruptive to the primary task of piloting.

HARRY DIAMOND LABORATORIES

A91-152 TITLE: Advanced Composite Solder for Microelectronics

CATEGORY: Exploratory Research and Development

OBJECTIVE: The fundamental issue for DoD in the 1990's is the cost of doing business. The U.S. is no longer able to afford current weapon systems. The Defense Manufacturing Board's Quality Committee estimated that 25% of electronic assembly costs is attributable to unnecessary solder joint rework. For surface mount components alone, rework approaches $3 billion per year on a worldwide basis. Clearly a need exists for an alternative to conventional soldering. HDL, together with industry and academia,submitted a patent application for ultra-high strength composite solders. A research effort aimed at transitioning this tech-base technology to industry needs to be performed. This HDL patent disclosure, along with the research, will have both DoD and commercial applications on a national basis.

DESCRIPTION: Conventional solder has poor material properties, i.e. low creep resistance and high susceptibility to grain boundary failure. Composite solder is constituted by means of physically blending powders of filler and tin/lead or tin-rich matrix of conventional solder, or by using other chemical, physical, and metallurgical means to dope the tin/lead or tin-rich matrix of conventional solder. It is expected that a composite solder will impart superior and desirable performance when compared to conventional solders; namely, decreased thermal expansion coefficient, increased intrinsic strength, increased creep resistance, increased fatigue resistance, and other enhanced material properties. These superior material properties enable solders to withstand harsher application environments with a higher reliability and lower cost. The fillers shall be selected and processed in a manner that the resulting composite not only achieves superior performance but also reduces or eliminates lead usage.

Phase I: Studies and experiments shall be performed to determine the appropriate filler material and its shape, size, and amount in the solder. Phase I shall provide data relevant to the development of composite solder's constitutive equations, molecular structure, and mechanical.

Phase II: Define, develop, and demonstrate a computer model of the composite solder matrix, the manufacturing parameters critical to process control, and the quality control inspection techniques for producing composite solders. Perform tests to allow transition of technology to MIL-STD-2000 soldering standards.

A91-153 TITLE: Microscale Fluidic Components for Acoustic, Robotic and Advanced Signal Processing Applications

CATEGORY: Exploratory Development

OBJECTIVE: The application of fluidic components to acoustics and hydraulic actuation systems has great potential for improving their sensitivity, ruggedness and reliability. By reducing the physical size of these components, their bandwidth will be increased, power requirement decreased, and more complex circuitry may be developed. These integrated fluidic components will then be useful in a wide variety of biotechnology applications from enhanced hearing devices to human strength improvement and robotics.

DESCRIPTION: The microminiaturization of fluidic components can have similar benefits to that of microelectronics. Fluidic components have been applied to acoustic tasks and actuation problems quite successfully. Current fluidic acoustic devices have sound pressure level sensitivities equaling the best microphones while being much more rugged. Fluidic amplifiers can interface with fiber optic signals and can be configured as servovalves with no moving parts. These devices will operate without sensitivity to electromagnetic energy. This makes them ideally suited for battlefield use in military systems. The miniaturization of fluidic components requires a knowledge of the fluid mechanics of flows in micro-sized channels. This effort will explore the limits of the Navier-Stokes equations with fluidic components in mind.

Phase I: Consists of a literature search for work in fluid flow in microscale channels, a dimensional analysis of the fluidic laminar proportional amplifier (LPA) to evaluate the effects of reducing its size and the fabrication of at least one structure (suitably sized test device) which can be experimentally evaluated. Finite element analysis of channels to verify experimental results and flow conditions within will enable the transmission of earlier results to the design of microfluidic devices. A plan of approach will include the fabrication and test of a variety of sizes of LPAs which reduce the size of the currently smallest useable device (.005 in. nozzle width) to sizes which will remain within the known region of the Navier-Stokes equations and even smaller to a size which will be expected to no longer perform according to normal Newtonian fluid flow phenomena.

Phase II: Consists of the manufacture and test of the variety of designs and sizes generated in Phase I. The modeling of flow phenomena within the device, using finite element analysis, will also be undertaken. The feasibility of fabrication of the microLPA will also be explored. This will include a study of suitable materials such as tungsten, tantalum, ceramic, or silicon and suitable manufacturing methods such as focused ion beam etching, reactive ion beam etching, chemical etching and laser machining.

A91-154 TITLE: Pulse Forming Network (PFN) for Expendable RF Source

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to build a Pulse Forming Network (PFN) that will store kilojoules of energy in an artillery shell to be used as an expendable RF source that can be placed in the immediate vicinity of the target.

DESCRIPTION: A directed energy weapon (DEW) for non-lethal applications requires the generation of gigawatts (GW) of peak RF power in order to damage unhardened target systems that are 10 kilometers (km) distance from the DEW. About 3 orders of magnitude less power is required to upset or temporarily disrupt the function of the target's electronics. A DEW capable of generating GW power levels would be very heavy (multi-ton), expensive and require protection as heavy capital equipment. An alternative strategy is to use an expendable source that can be delivered by an artillery shell and placed in direct vicinity of the target. Significantly less energy is required by this strategy because the 1/R2 range decay and atmospheric absorption drastically reduces the energy on target. The artillery shells with the PFN can be leisurely charged from a truck battery and trickled charged until launched. The PFN would store GW of peak power and kilowatts (kw) of average power in a standard 155mm artillery shell and deliver hundreds of pulses on the target before it exhausts the energy supply. An important point is that this method of deployment leaves the prime power source (batteries) behind and converts the DC stored energy to RF energy directly over the target. Some important applications are to disable incoming missiles, disable C3I installations prior to attack, disengage a homing missile, frustrate fire control systems of unidentified aircraft and defense against terrorist attack (disable their electronic systems without harming hostages).

Phase I: Consists of conducting a literature search to obtain information on components

necessary to design a PFN that can fit into a 155mm shell, store kilojoules of energy and gigawatts of peak power, convert DC energy to RF energy, and deliver the energy to an antenna. Critical components to be investigated are capacitors, inductors, switches, and low-loss, high dielectric materials. Two designs for the PFN should be obtained. One design for generating a burst of pulses at a reprate greater than 3 kilohertz and the second for generating one large pulse. Both designs require a radiated pulse risetime less than 1 nanosecond (500 picoseconds preferred) in order to generate power in the microwave spectrum.

Phase II: Consists of the building and testing of a PFN to one of the designs obtained in the Phase I effort and as determined by the government representatives.

A91-155 TITLE: Subnanosecond Turn-On, REP-Rated Opening Switch

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this program is to develop a compact opening switch that can turn-on in picoseconds with a peak power capability in the gigawatt (GW) regime and average power capability in the hundred kilowatts (kw) regime. The switch should also be capable of operating at high reprates.
DESCRIPTION: Compact pulsers are urgently needed by the Army to develop directed energy weapons (DEW) for nonlethal and lethal applications. The switches in these pulsers are critical components because they play a major role in energy storage and power conditioning. The switch determines to a large extent the pulse characteristics (conditioning) and the peak and average power that can be distributed to the load. A opening switch is required for pulsers using inductive energy storage. The switch must be capable of opening in sub-nanosecond times to generate pulses that have significant power at microwave frequencies. In addition, a high repetition rate capability is required for the opening switch because a wide range of target systems may have their performance degraded by upset and interference when irradiated with electromagnetic energy (EM) in a high-reprated, pulsed mode.

Phase I: An investigation and literature search will be conducted to determine the switch technology (plasma, vacuum, solid state, etc) most suitable for obtaining the target specifications given below for the opening switch. The specific switch technology shall be chosen from the information obtained from the literature search and a design of a candidate switch shall be generated that is aimed at meeting the target specifications given below. The switch design should be compatible with low-cost and compactness. The design information obtained under Phase I shall be adequate to allow the government representatives to determine the merit of the switch and to assess the program progress.
Target Specifications for the Opening Switch:
minimum current: 10 KA
minimum peak power: 10 GW
minimum average power: 125 KW
minimum energy/pulse: 50 J
minimum repetition rate: 3 KHz
load impedance: 150-200 ohms
operating life: 200 cycles (pulses)
turn-on time: < 1 nanosecond

Phase II: Consists of designing, building and testing a packaged opening switch that meets the specifications given above.

A91-156 TITLE: RF Diode Laser Modulator

CATEGORY: Exploratory Development

OBJECTIVE: It is sometimes useful to detect the presence of a target within a specified area, for

example a collision avoidance system or a proximity fuze. It may also be useful to have a system which detects the target's relative velocity and range or distance from the detection system. A successful project would be incorporated in an Army target detection research program. This program is evaluating various cw laser diode modulation techniques for short range target range/velocity detection.

GENERAL: With the advent of inexpensive, reliable cw laser diodes, the Army is looking for modulation schemes using cw laser diodes for short range target detection. One such modulation scheme involves amplitude modulating the laser light, with the frequency of the modulation varying from 50 MHz to 400 MHz. This modulation scheme allows the detection of the target, and also gives information about both target speed and range. To implement this scheme it is necessary to construct a laser modulator with a bandwidth of 350 MHz which is flat over the frequency range mentioned above. The modulation waveform can be either sinusoidal or square, but the waveform must be consistent over the frequency range. The modulator should be capable of sweeping over the entire frequency range at a 10 kHz rate. The RF input signal to the modulator will be < O dBm. The RF input impedance of the modulator should be 50 Ohms. The input power supply voltage cannot exceed 100 V DC at 5W, -15 V at 2.5 W. The modulator should be integral to the laser diode chip, with both the laser diode chip and the modulator mounted in the same package. The maximum acceptable package size would be comparable to a T0-3 package. It is envisioned that the laser light output would be modulated by modulating the laser drive current, but a modulator using electroptic techniques is acceptable if it fits the above specifications.

Phase I: Consists of the design of a modulator for cw laser diodes with optical powers of around 30 mW and around 90 mW. The light frequency of the laser diodes could be in the Si detector region of the spectrum for overall system efficiency or at longer wavelengths for eye safety requirements. The 90 mW laser diode can be a series of closely spaced laser diode active regions such as the Sharp LTO90MD diode.

Phase II: Consists of the integration, packaging, and testing of the laser diode modulators with the laser diode chips.

A91-157 TITLE: Unobtrusive Air Chemistry Diagnostics for Aurora

CATEGORY: Advanced Development

OBJECTIVE: Develop and demonstrate unobtrusive, turn-key air-chemistry monitoring diagnostics to be permanently installed at the Aurora nuclear simulator.

DESCRIPTION: Permanently available and unobtrusive air chemistry diagnostics would considerably benefit the Aurora simulation facility in the following three ways: First, air-chemistry research can be piggy-backed on nuclear effects testing sessions at the facility, thus giving the simulator a multiple simultaneous-use character. Secondly, such an installation would significantly enhance the facility's diagnostic capabilities, and therefore the quality of air-chemistry-related research being performed. Third, such a package would benefit effects testers by providing higher quality characterization of the simulation environment.

The diagnostic installation must be able to measure air chemistry parameters without interfering with on-going testing. Rf and/or photonic methods of monitoring such parameters as electron density and collision frequency appear particularly desirable. The diagnostics must prove accurate, they must be immune to the harsh environment of the simulation region, and they must have sufficient dynamic range to cover all parameter ranges realized at the facilities. The equipment must be sufficiently reliable and easy-to-use for routine use, and should have a data acquisition/analysis time which matches the turnabout time of Aurora.

Phase I: Demonstrate the feasibility of the proposed diagnostic packages by analysis and/or proof-of-principal tests.

Phase II: Build and install an air chemistry diagnostics station for permanent routine use at

Aurora. Provide a users manual and training.

A91-158 TITLE: Electron Beam and Plasma Diagnostics for Drift Tube-Enhanced Gamma Simulator

CATEGORY: Basic Research

OBJECTIVE: To develop diagnostic techniques and sensors that provide spatial and temporal resolved measurements of critical parameters for drift tube-enhanced gamma simulation. Develop a test bed to evaluate cost effectiveness techniques for producing a variable ionizing radiation pulse shape. The ultimate goal is to make the Aurora a versatile, cost effective x-ray simulator for a broad spectrum of D.O.D. and contractor users who are interested in state-of-the art nuclear weapons effects testing.

DESCRIPTION: Risetime enhancement of the pulsed, relativistic electron beam from the Aurora simulator can be obtained by propagation of the beam through low pressure gas. In order to understand and optimize the system, measurements of power flow, beam and plasma parameters are required. Quantities of interest include voltage and current along the vacuum coax to the diode, beam current density and electrode plasma parameters in the diode, beam and plasma currents and densities in the drift tube, and electron energy. In addition, precise knowledge of the neutral and plasma density and plasma temperature are of interest. The techniques should be non-invasive and non-perturbing wherever possible.

Phase I: In the preliminary effort, the proposed diagnostics should be analyzed and proof-of-principal experiments should be conducted. The tests should include a means for calibration. Based on the evaluation of test results, plans for developing more advanced prototypes to be implemented on the Aurora drift tube apparatus should be made.

Phase II: Advanced prototypes of these diagnostics will be developed, analyzed and deployed on the Aurora simulator. Development should proceed toward providing reliable and user-friendly diagnostic packages that accurately measure parameters for input to a variety of computer simulations and models. Development should include studies of improvements in packaging and reliability that may be appropriate in Phase III.

A91-159 TITLE: Parameter Testing of Multi-Branched Shielded Cables

CATEGORY: Exploratory Development

OBJECTIVE: The purpose of this work is the characterization of multi-branched/multiwire shielded cables such that measurable electrical parameters can be defined for the purpose of parameter testing and measurement.

DESCRIPTION: Shielded cables are employed within Army systems and provide protection against Electromagnetic Pulse (EMP), Electromagnetic Interference (EMI) and other external Electric Over Stress (EOS) to electronic equipment. These shielded cables are subjected to harsh operating environment and abuse and are known to degrade with time. Maintenance testing of single cable lengths as a two port distributed parameter network will provide the impedance transfer junction which is then tractable for frequency analy analysis. Multi-branched/multiwire shielded cables introduce an order of complexity since the problem becomes one of multi port network analysis with termination into mismatched loads. The problem is further compounded when multi twisted wire lengths, both shielded and/or insulated, are introduced.

The technical approach to this problem could include, but need not be limited to, the use of time domain reflectrometry, development of transfer functions including the transfer impedance, singularity expansion method, pole/zero resonance characterization, Thevenin equivalent, N-Port network

representations, transmission line analysis, and antenna analysis concepts. The analytical development should provide guidance and understanding to the main objective of developing a quantitative testing procedure for determining/assessing cable degradation. It is expected that for large complex cables with multiple branching and many internal components that statistical concepts/analysis will be used in the characterization to keep the amount of test data/measurements tractable. The statistics might be employed to develop envelopes of measurable parameters, or threshold values in either the time or frequency domains, that would identify the onset/presence of cable degradation.

Phase I: This phase consists of the mathematical development of multi-port cable networks and the development of network models for computer simulation and analysis. Parametric variations in the simulation will be such that the observable changes can be measured in physical cable networks.

Phase II: Model validation will be performed on 10 sets of new MI branched fire control cables, GFE, followed by additional used cable sets. The validation testing will emphasize general purpose test equipment and TMDE that is available at the Army depot maintenance level and not special lab instruments.

A91-160 TITLE: Time Dependent Beam Density Techniques

CATEGORY: Applied Research

OBJECTIVE: Apply advanced measurement techniques to nondestructively measure time dependent electron beam density.

DESCRIPTION: The current density as a function of position and time is an important characteristic in plasma physics, and in particular, describes the accelerator's beam output. This measurement would provide better capability in cathode design, and the ability to tailor the electron beam to the experimental goal. Novel approaches towards this end would enhance the laboratory capability to simulate High Power Microwave (HPM) effects. Dynamic range of 10 - 1000 Amps/cm2 is required.

Phase I: The results of this effort should prove the feasibility of the concept through calculations, modelling, designs, and preliminary experiments. The theoretical detail should be understood, dynamic range of the device should be determined, and a plan to test the current density measuring device should be formulated for Phase II.

Phase II: The scaled prototype should be designed, fabricated, tested and evaluated. The basic measurement technique should be validated. The results should be extrapolated to a preliminary design of hardware that could be installed and tested at Harry Diamond Laboratories High Power Microwave Test Facility in Phase III.

A91-161 TITLE: Automated Composite Material Inspection System

CATEGORY: Advanced Development

OBJECTIVE: Develop hardware, software, and specific technology to perform real-time detection and flaw identification on and within Composite Materials.

DESCRIPTION: The use of Composite Materials for military hardware has dramatically increased in the past 10 years. Many of these materials have replaced metal and much has been applied to low observable technologies. Existing inspection technologies remain limited when performing precise detection and assessment of surface defects (cracks, scratches, non-uniform surface) and internal flaws (delamination, voids, crushed cores, etc.). To improve Composite quality and reduce manual inspection costs, a system is needed to automate the inspection of Composite materials.

Phase I: Develop and design a system to adapt existing knowledge of automated inspection and

apply these techniques to Composite material inspection.

Phase II: Fabricate a prototype system to demonstrate capabilities. Deliverables would include a final system analysis, a technical data package, and a prototype system suitable for evaluating sample Composite materials. The developer will setup and assure system viability, and if necessary make adjustments to optimize system performance.

A91-162 TITLE: Advanced Technology Applied To Hardness Maintenance/Hardness Surveillance

CATEGORY: Exploratory Development

OBJECTIVE: It is anticipated that successful project would lead to new methods and techniques to perform hardness maintenance/hardness surveillance (HM/HS) on critical Army mission equipment that must survive Electromagnetic Environment Effects (E3). The objective of this project is to apply advanced computer technology, such as expert systems, artificial intelligence, neural networks and signal processing, to develop innovative HM/HS methods and techniques.

DESCRIPTION: The Army performs HM/HS on critical systems to maintain their ability to survive the E3 threat. The level and method of HM/HS performed varies from system to system due to their differing complexity and other factors. A system independent methodology is highly desirable. The performance of HM/HS operations on these systems can be time consuming and may require specialized training and specialized test equipment. The analytical skills needed are difficult to acquire and retain, leading to poor HM/HS performance. Recent advances in computer hardware and software technology (e.g. digital signal processor boards, video acquisition image processing and artificial intelligence) make it feasible to develop sophisticated computer systems that emulate the performance of humans within narrow domains of expertise.

Phase I: Review E3 survivability HM/HS requirements and identify potential areas and methods that could be enhanced or improved through the application of advanced computer technologies. Develop conceptual HM/HS techniques or methodologies that capitalize on hardware and software system advances. It must be possible to demonstrate a significant improvement in HM/HS and testability performance with the new methodology, such as higher fault detection capability, lower operator skill level requirements, or shorter maintenance/surveillance time. The resulting concept should be completely developed. Critical elements of the new approach should be demonstrated through rapid prototyping or other suitable means.

Phase II: Consists of developing a prototype HM/HS system and demonstration of its performance.

MATERIALS TECHNOLOGY LABORATORY

A91-163 TITLE: "Smart" Nondestructive Evaluation Sensor Systems for In-Process Control and In-Situ Monitoring

CATEGORY: Exploratory Development

OBJECTIVE: Development of nondestructive evaluation "smart" sensor systems for in-process control of manufacturing lines producing Army materiel, and in-situ nondestructive evaluation (NDE) "smart" sensor systems for monitoring the condition, performance, and balance of life of the material (and its structure). This effort will have phase III potential in a large number of Army manufacturing programs (e.g. helicopters, electronics, tracked/wheeled vehicles, troop support items, missiles, etc.) as well as

in-service, in-storage; or undergoing rebuild applications. This will lead to reduced cost and higher quality/reliability of manufactured items both military and commercial.

DESCRIPTION: Worldwide competitive pressures are mandating efforts at developing and perfecting "smart" sensor systems which are capable of monitoring and controlling the materials production process; materials stability during transport, storage, and fabrication; and the amount and rate of degradation during the materials in-service life. These "smart" sensor systems will not only serve to monitor and optimize process or cure parameters for the material, but will provide the opportunity for real time NDE of the material while the structure is performing. The "smart" sensor" systems will incorporate advanced signature analysis processing methods to provide real time decisions on the components/process condition. The sensors should be inexpensive, and very simple to induce the governemt/manufacturers to install them in production lines. In many applications, such as composites and microelectronics, extremely small sizes are mandatory (e.g. less than 0.1 mm thickness for composite monitoring).

Phase I: Demonstrate the feasibility of developing nondestructive evaluation "smart" sensor systems (as defined above) for in-process control of manufacturing lines producing Army materiel, and in-situ "smart" sensor systems for monitoring the condition, performance, and balance of life of the material (and its structure).

Phase II: Prototype "smart" sensor systems (as defined above and developed in Phase I) will be fabricated and demonstrated on appropriate Army applications/components/end item samples selected.

A91-164 TITLE: Intelligent Database Management System

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop an intelligent database management system for computerized polymer and polymer composite materials property data. The system will incorporate knowledge/expert system and relational database technologies to facilitate communication and consultative applications. The database design and nomenclature must be consistent with guidelines specified by ASTM Committee E-49 on Computerization of Material Property Data.

DESCRIPTION: ASTM Committee E-49 has developed guidelines for computerization of polymer and polymer composite material properties. A primary purpose of the guidelines is to facilitate efficient storage and retrieval of materials property information to enable exchange and comparison of data from different sources. The guidelines also address standardization of terminology and test methodology and provide a classification system for tabulating properties of polymer and polymer composite materials. Future materials databases in industry and government will be required to conform to these guidelines. Unfortunately, in practice there often are questions regarding data validity and essential materials property data frequently are either missing or not available in appropriate formats. Future materials databases need to be relational and incorporate knowledge base technology to allow users to assess the validity of data and obtain estimates of missing information. An Intelligent Database Management System (IDMS) is needed to assist information (both data and knowledge) acquisition and handling, enhance compatibility with other systems, and provide flexibility for diverse user applications.

Research indicates that an IDMS might be designed by integrating two distinct systems (a shell-based knowledge management expert system and a relational database management system) using state-of-the-art computer hardware and AI/database software tools. The two systems could be "loosely coupled" in the sense that minimal modifications to either system would be necessary with the database management system acting as a back-end server to the expert system, supplying data that the expert system requires. Each system would retain its identity to do what it is designed to do best; i.e., the expert system devoted to deductive functions and the database management system managing the database. Operationally, the total system would (1) function as a database and include all attributes required for polymer and polymer composite materials identification and property specification and (2)

serve as a consultative expert system. Features such as compatibility, multi-user capability, portability, cost, natural language interface, user friendliness, mass data/knowledge storage and security also need to be considered.

Phase I: Design and demonstrate the feasibilty of an IDMS for computerization of polymer and polymer composite materials property data/knowledge.

Phase II: Develop a prototype of the system demonstrated in Phase I. Deliver the system with source code and instructions for user evaluation.

A91-165 TITLE: Digital Image Monitoring of Fracture Processes

CATEGORY: Exploratory Development

OBJECTIVE: To develop real-time digital image processing techniques for analyzing/monitoring fracture processes and
dimensional changes in polymer composite specimens during mechanical testing.

DESCRIPTION: Research has demonstrated the feasibility of using digital image processing techniques to determine dimensional changes and analyze qualitative and quantitative fracture processes in polymer composite test specimens due to environmentally- and mechanically-induced stresses. The application of image analysis techniques during mechanical testing has been shown to facilitate test automation and to provide information essential to the interpretation and quantification of mechanical test data. However, fracture processes are often complex and may extend over large regions of test specimens. Test specimens may have different sizes, shapes, colors and fracture characteristics which further complicate image analysis. Also, since fracture is a dynamic process, real-time (high speed) image acquisition and special image processing techniques are needed to determine specimen size and shape changes, identify where fracture is initiated, and describe how fracture develops in specimens during mechanical testing. Images must be classified and interpreted in terms of appropriate fracture models to facilitate the analysis of mechanical test data and provide a quantitative assessment of damage. By combining visual information with mechanical test data (applied stresses, strain, strain rate, fatique cycle, creep time, etc.) and related experimental information (e.g., infrared thermography and acoustic emission), improved fracture models and a better understanding of mechanical failure processes in complex materials, such as polymer composites, will be possible. Machine vision/digital image analysis techniques are needed to acquire, interpret and archive visual images of polymer composite material specimens during mechanical testing. The vision/image processing system must be relatively compact and compatible with standard mechanical test equipment. State-of-the-art vision technology may be employed and image processing should be feasible within the domain of current work station/mini-computer technology. Novel computer software, artificial intelligence and/or parallel processing techniques may need to be developed. The techniques should be generally applicable to a range standard mechanical test methods (e.g., tensile, shear and compression) and various material specimen types, sizes and shapes.

Phase I: Investigate and demonstrate the feasibilty of developing a real-time vision system to acquire, interpret and archive visual images of polymer composite material specimens during mechanical testing.

Phase II: Optimize and develop a prototype of the system demonstrated in Phase I. Demonstrate that the system has the capability to acquire images in real-time and process visual information to determine dimensional changes, locate the region(s) where mechanical failure is initiated, and define fracture type and growth rate for various types of test methods and specimens.

A91-166 TITLE: Dry In-line Thermoplastic Matrix Impregnation

CATEGORY: Exploratory Development

OBJECTIVE: Develop a general process module which can be placed in-line on existing filament winding, pultrusion and prepregging equipment, to impregnate dry thermoplastic matrix materials onto the passing continuous fiber rovings. The general concept of the developed process module must be easily adaptable to the three above mentioned polymer composite production methods with only minor design alterations from the general concept. Phase III military and civilian applications for this process module include production of filament wound, pultruded and prepreg thermoplastic matrix composite materials.

DESCRIPTION: Thermoplastic matrix materials perform better at elevated temperatures than do the more common thermosetting materials in widespread use today. Combining thermoplastic matrix materials with continuous fiber tows is a difficult task which commonly requires "wet" solvent, slurry or emulsion solution dipping. The solution must later be driven off. In addition some of the solvents used are health hazards as well as environmental pollutants. An in-line dry-coating module approach offers two advantages: the health issue is eliminated, and the number of processing steps is reduced, which in turn will lower the cost of manufacture. The developed process must not be rigidly dedicated in design to suit one particular composite production method but rather it must be flexible in concept so as to be adaptable to be placed in-line with existing filament winding, pultrusion and prepregging production equipment. The task of developing a general equipment concept which can be further tailored to the three specific production methods mentioned is critical to this program. Thermoplastics used for testing must be in current common use as structural composite matrix materials.

Phase I: Review state-of-the-art dry impregnating technology. Develop a general design concept that is adaptable to in-line use with filament winding, pultrusion and prepregging production methods with only minor design alterations. Develop a prototype for an in-line dry impregnation module for filament winding and demonstrate clear potential for successful scale-up.

Phase II: Complete and optimize the design concept for full scale working prototype modules adaptable for the three fabrication techniques reviewed in Phase I. Construct prototype modules and physically demonstrate successful and reliable fiber impregnation.

A91-167 TITLE: Smart Environmental Sensors for Monitoring Prepreg Durability

CATEGORY: Exploratory Development

OBJECTIVE: To develop low cost, miniaturized environmental sensors for monitoring prepreg durability. Potential Phase III applications include "smart sensors" that could be packaged in other environmental sensitive pharmaceutical, biotechnology or food products.

DESCRIPTION: Fiber reinforced thermoset prepregs are shipped from the supplier at low temperatures to prevent material degradation. In order to prevent further deterioration and prolong "shelf life", the composite manufacturer stores the prepreg at low temperatures until it is ready for use. These materials have a known finite useful life at room/elevated temperatures. At these environmental conditions, chemical changes (homopolymerization, hydrolysis, etc) occur which cause the prepregs to be "boardy", unprocessable or have lower mechanicalproperties/longterm durability. The goal of this research is to develop a low cost, miniaturized, possibly reusable and programmable, environmental sensor that would be packaged along with the prepreg by the supplier. The smart sensor would have an environmental sensor and time indicator/recorder that would either visually indicate (or store/record for subsequent readout) the time the material was at a preset temperature extreme. Other sensors could be developed that would indicate humidity or light environmental extremes.

Phase I: Develop innovative concepts and demonstrate the feasibility of smart sensors for monitoring prepreg durability by time/temperature history of the material.

Phase II: Optimize sensor technology of the most promising concept(s) that evolved from Phase

I. Fabricate a prototype sensor(s) and evaluate its effectiveness in monitoring the durability of selected prepreg materials.

A91-168 TITLE: 2-D Non-contacting Strain Measurement Device

CATEGORY: Exploratory Development

OBJECTIVE: To develop a 2-D non-contacting device to measure strains during mechanical testing. Potential Phase III applications include replacement of existing strain measuring devices in government and commercial testing facilities.

DESCRIPTION: Current methods of stain measurement are good for low stains, but are often difficult to apply to large stains. It is desirable to have a non-contacting measurement devices to be used with conventional servohydraulic testing machines and requiring no targets or other specimen surface modifications. This system should be capable of measuring strains on both elastomer and composite specimens in real time. Accurate measurement of both large and small strains in tension, shear or other testing modes is required. The desired system should function in a variety of environments such as high temperatures.

Phase I: Determine feasibility of system to meet the above requirements, develop a working "breadboard model" to meet requirements, and conduct laboratory tests to verify performance of system.

Phase II: Design and fabricate a prototype system as developed in Phase I. Phase II could also include the addition of a high resolution recording device for a visual record of failure. The end product will be a prototype instrument meeting the requirements outlined above.

A91-169 TITLE: Field Portable Non-Contact NDE System for Composites

CATEGORY: Exploratory Development

OBJECTIVE: To develop a practical field portable Nondestructive Evaluation (NDE) system for rapid inspection/evaluation of a variety of large composite structures. Potential Phase III applications for this NDE system include primary helicopter/fixed wing aircraft structures and ground vehicle and automotive components.

DESCRIPTION: The Army has a need to optimize current or develop a next generation NDE system to characterize environmental degradation/ physical-mechanical damage and to evaluate the structural integrity of fielded and repaired primary composite structures during service life. The goal of this research is to develop an innovative/integrated NDE system with the following must have specifications: Single sided, non-contact, High sensitivity, Real time video/menu driven computer based, Field portable and durable, Rapid scanning (ft/min), Large scanning area, Detects delaminations, cracks, unbonds, crushed cores, porosity in bonded and laminated composites and sandwich structures. Desirable specifications include flaw depth location, surface strain analysis and/or modal property determination. Innovative approaches that include the integration of two complementary techniques would also be favorably considered.

Phase I: Investigate and demonstrate the feasibility of developing an innovative NDE system, as specified above, to characterize a variety of composite structures of interest to the Army. Compare the advantages and disadvantages of this proposed system to standard NDE techniques.

Phase II: Select and optimize the most promising techniques addressed in Phase I. Develop and deliver a complete integrated prototype system and demonstrate its application on large composite structures.

A91-170 TITLE: Development of a Tungsten Heavy Alloy that Fails by an Adiabatic Shear Mechanism

CATEGORY: Exploratory Development

OBJECTIVE: Develop a tungsten heavy alloy that, when used as a kinetic energy penetrator, will ail, during the penetration event, by a adiabatic shear mechanism.

DESCRIPTION: Tungsten heavy alloys and depleted uranium (DU) alloys are competitive materials for use as kinetic energy penetrators. When the performance of these alloys is compared, in the long rod configuration, the DU penetrators always penetrate further. The reason for this better performance has been attributed to the favorable conditions for adiabatic shear in the DU alloy. It has been shown that the nose of the DU penetrator "self-sharpens" and maintains a chisel nose that keeps the diameter of the penetration hole at a minimum. On the other hand, tungsten heavy alloys do not shoe this type of behavior. The heavy alloys, during penetration, tend to form mushroom noses that act to increase the penetration hole diameter causing a premature dissipation of the kinetic energy.

The principal materials variables that affect the formation of adiabatic shear bands are: the rate of thermal softening, the rate of strain hardening, strain rate hardening, the thermal properties and the microstructural stability. In depleted uranium alloys used for penetrators these properties are in the correct balance to form adiabatic shear bands at the strain rates encountered in the penetration event. They are not advantageous for tungsten heavy alloy matrix. But to further complicate matters, the tungsten grains may act to blunt the adiabatic shear band and it may be required that the tungsten grains be smaller than the width of the shear band that forms.

Phase I: The effort in Phase I should concentrate on identifying matrix materials that will form adiabatic shear bands at the strain rates of ballistic interaction. It should be demonstrated that these materials form the shear bands and, further, these materials must be compatible with the tungsten heavy alloy system concept. The materials identified should undergo vigorous mechanical testing, not just static properties but, more importantly, high strain rate properties. And all materials should be microstructurally characterized.

Phase II: Phase II should further refine the alloy selection, demonstrate the fabrication of the alloys and demonstrate adiabatic shear band formation in the ballistic event.

A91-171 TITLE: Strain Measuring Device for High Strain Rate and High Heating Rate Testing

CATEGORY: Exploratory Development

OBJECTIVE: Development of a strain measuring device to measure a strain field on a surface of a specimen or structure under a high strain rate and high heating rate environment.

DESCRIPTION: Current strain measurement techniques have limited applications in a dynamic environment. Strain gages can only be used to measure local strain in a temperature below 1000 degrees F, while clip gage measure average strain quasistatically in a somewhat higher temperature. In any case, strain field in specimens/structures subjected to high strain rate and high heating rate cannot be experimentally determined with any degree of accuracy. The objective of this effort is to develop a device to measure a whole strain field on surfaces of specimens/structures subjected to high strain rate and high heating rate. The suggested approach is to develop non-contact (most likely optical device) strain measuring device for use at high strain rate and temperature rate.

It is known that materials behave differently when they are subjected to various loading (heating rates); therefore, it is necessary to perform experiments under such environment to determine material

responses. The most difficult problem in performing such experiments is to measure the strain. All current strain measuring devices require a direct contact with the specimen/structure; this requirement limits the use of such devices because the integrity of the devices themselves must be maintained during the experimentation. Furthermore, the devices must have a fast response to record all information in less than 10 milliseconds. In summary, the strain measuring device must be a non-contact one and have a fast response.

Phase I: Investigate and demonstrate the feasibility of developing a rugged strain measuring device to measure the strain field of a specimen or the local strain field on a structure surface in a high strain (loading) rate and high heating rate (also high temperature to 2000 degrees C) environment.

Phase II: Optimize and develop a prototype of the device demonstrated in Phase I along with any necessary auxiliary equipment and software. Demonstrate that this prototype has the capability to measure a strain field at 2000 degrees temperature and full response in less than 10 milliseconds.

A91-172 TITLE: Novel Surface Treatments for Improved Adhesive Bonds

CATEGORY: Exploratory Development

OBJECTIVE: To develop surface treatments for metals which modify their surface chemistry so as to permit the formation of stronger, more durable adhesive bonds to them.

DESCRIPTION: Conventional coupling agent chemistry has been applied extensively to the problem of adhesive bond strength and durability with modest success. Novel approaches resulting in very substantial enhancements are required for demanding military applications of this advantageous joining technology. By analogy with carbon chemistry, where highly reactive species are generated on its surface by high temperature vacuum pyrolysis and subsequent reaction with monomers and other small molecules, it is of interest to functionalize metal surfaces through the interaction of similar small molecules with appropriately activated surfaces. Of particular importance are the advanced structural metals such as aluminum where a native oxide is always present on the surface.

Phase I: The feasibility of the process for functionalizing would be determined. The effect of such surfaces on the quality of bonds to them would be ascertained.

Phase II: promising approaches identified in Phase I would be brought to the point where they could be implemented in production. This would include the scale-up of any necessary equipment and the generation of data as to the effect of variation of important processing parameters on the quality of resultant adhesive bonds. The specific product of this phase would be a Technical Data Package sufficient for the implementation of such a process on a production line.

VULNERABILITY ASSESSMENT LABORATORY

A91-173 TITLE: Large Duty Cycle Pulsed Semiconductor Diode Lasers

CATEGORY: Exploratory and Advanced Development

OBJECTIVE: To develop pulsed semiconductor diode lasers with duty cycles greater than 0.4%.

DESCRIPTION: There is a need to research methods of constructing pulsed semiconductor diode lasers with duty cycles greater than 0.4%. Present day pulsed semiconductor diode lasers have 0.014% duty cycles within the emission wavelengths of 800 to 1100 nanometers. Typical pulse lengths and repetition rates are 100 nanoseconds and 1 kilohertz, respectively. The required pulsed semiconductor diode lasers with the larger duty cycle will be used in the construction of rail jammers for field and laboratory work.

A typical rail jammer might have a pulse length of 10 to 100 nanoseconds and a repetition rate of 50 to 100 kilohertz. Although present day diode lasers are small and rugged, their pulse lengths and repetition rates (i.e., duty cycles) are too slow to meet the requirements of a rail jammer.

Phase I: Theoretical study to determine the feasibility of developing a pulsed semiconductor diode laser with large duty cycles.

Phase II: This effort will result in the prototype developement of a pulsed semiconductor diode laser with large duty cycle compatible for use with rail jammers.

AVIATION SYSTEMS COMMAND

A91-174 TITLE: Design Methodology of Low Susceptible Rotor Blades

CATEGORY: Exploratory Development

OBJECTIVE: Develop and validate innovative blade design and/or control concepts for reduced acoustic and IR radiation.

DESCRIPTION: Rapid increase in capabilities of ground-based air defense systems to detect, track, and identify a rotorcraft poses a growing threat for US combat helicopters. Therefore, a heavier emphasis should be placed on the low observability aspects of the current and new generation of helicopters. The low observable characteristics are intended to delay or minimize the chances for detection of these rotorcraft during penetration of hostile airspace, thus increasing the likelihood of successful mission completion. New technologies should be pursued to alter the characteristics of or reduce various radiation of a rotorcraft to improve survivability.

Phase I: Develop analytical tools to predict noise and IR radiation in terms of aerodynamic parameters of rotor blades and parameters of advanced detection systems. Develop an optimum design methodology to achieve the objective.

Phase II: Design and validate the optimum concept at a wind tunnel in which a 10-foot rotor system is desirable.

A91-175 TITLE: Advanced Computational Fluid Dynamics Methods for Elastic Helicopter Blades

CATEGORY: Basic Research

OBJECTIVE: Develop and demonstrate the ability to predict the quantitative aeroelastic features of the flexible blades of modern high-performance helicopter rotors, using advanced computational fluid dynamics (CFD) techniques. Provide the capability to design a superior blade for increased performance, reduced vibrations, and greater maneuverability.

DESCRIPTION: Nonlinear aerodynamic phenomena on flexible helicopter rotor blades restrict the maximum thrust of the rotor, increase the power required, produce unacceptable pitch-link loads and vibratory stresses, and in severe cases, cause catastrophic stall flutter. Recent progress in analyzing and predicting these complex aerodynamic phenomena on rigid blades by modern CFD methods has been

promising, but nothing has been done to couple these advanced codes with structural dynamics methodology for the elastic blades that are actually used on modern helicopters. Furthermore, the complex interdisciplinary nature of rotorcraft, which encompasses aerodynamics, structural dynamics, flight controls, and propulsion, has inhibited the development of comprehensive tools to accurately predict important rotorcraft characteristics.

The Army has undertaken the development of advanced CFD codes for nonlinear aerodynamics of rotor blades, to remove the limitations of approximate theories, and the development of a Second Generation Comprehensive Helicopter Analysis System (2GCHAS), to overcome the deficiencies earlier comprehensive analyses have. The 2GCHAS system is designed to evolve in a modular fashion as new technology becomes avaiable. The initial system uses conventional aerodynamics technology, but the full potential of future supercomputers for rotorcraft applications will not be realized until advanced CFD methods are integrated into 2GCHAS. The integration will require careful analysis of the 2GCHAS system requirements, the development of optimal software architecture, and significant modifications to the usual CFD approaches used in fixed-wing aerodynamics.

Phase I: Two principal results should be achieved during the Phase I study. First, the governing equations and boundary conditions appropriate to a rotating blade should be derived, including the direct aeroelastic coupling between the flow field and the blade motion, and a satisfactory explanation of how the rotating-blade formulation will be implemented in the eventual numerical code must be given. Second, innovative methods of solving the combined set of equations should be developed and demonstrated for the relatively simple model problem of inviscid flow, with or without compressibility effects. This development should enable the CFD code to be substituted for the aerodynamics module in the 2GCHAS system. Preliminary validation of the numerical method by comparisons with experimental results would be desirable, but not required at this stage if satisfactory progress is documented.

Phase II: Validation of the numerical method by comparisons with experimental results, for which the Aeroflightdynamics Directorate experimental data will be made available, must be undertaken early in Phase II. If appropriate, adjustments to the aerodynamics and structural dynamics models may be made at this stage. The extension of the numerical methodlogy to viscous compressible flow shall be accomplished, within the architecture of the 2GCHAS system. In this phase, innovative methods of coupling the near-field aerodynamic calculation to the mid- and far-field wake should be investigated. Detailed comparison with and validation by means of comparison with model or full-scale rotor experiments is highly desirable.

A91-176 TITLE: Acoustic Array Technique for Wind Tunnel Applications

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this proposed topic would be to incorporate the existing knowledge in acoustic array techniques for helicopter acoustic research into a wind tunnel application.

DESCRIPTION: The free world's best wind tunnel for aeroacoustic research exists in the Netherlands, and is used heavily by the NASA for fundamental studies of helicopter source noise mechanisms. NASA must utilize this facility because there is nothing comparable in the United States at the scale needed for helicopter noise research. Over the past several years, NASA Langley has developed a design for a complex aeroacoustic research facility that is primarily directed at model scale rotorcraft requirements. As the 'next' generation aeroacoustic wind tunnel, this facility promises to advance the knowledge of helicopter acoustic characteristics, However, such a facility will be very expensive, and construction would take many years. In the interim, development and refinement of acoustic measurement and analysis techniques may provide viable research opportunities in helicopter acoustics in existing NASA facilities.

The goal of this SBIR is to demonstrate the potential of the beam-forming capabilities of a

multi-element array in eliminating, or at least rendering negligible, both the background noise and hard surface reflected noise typically inherent in all wind tunnels not specifically designed for acoustic applications. By carefully designing and electronically steering the array, the acoustic signals that did not emanate from the source could be greatly attenuated. In evaluating array capabilities careful consideration should be given to the following interests:

1) Helicopter model frequency content
2) Helicopter model size
3) Array 'acceptance' beam size
4) The ability to measure directivity characteristics
5) The ability to 'point' the array to specifically examine localized sources on the helicopter model
6) In-flow/Out-of-flow measurement capability
7) Array physical size relative to wind-tunnel size
8) Maintaining a reasonable number of array elements

Phase I: The expected results would be an evaluation of the feasibility and potential benefits of using array techniques in facilities like the Langley 14- by 22- Foot Subsonic Tunnel in the 'open throat' configuration.

Phase II: Extend this effort into development that would include an application of the technique in a large non-anechoic wind tunnel as well as computer code for general array design applications in wind tunnels.

A91-177 TITLE: High Temperature, Abradable Coatings for Turbine Engine Compressors

CATEGORY: Exploratory Development

OBJECTIVE: To develop an abradable material or material system which can be easily and economically applied to turbine engine centrifugal compressor shrouds to improve performance.

DESCRIPTION: The compression systems of current and future gas turbine engines require extremely tight clearances in the high pressure compressor in order to obtain and maintain high performance levels. One approach to achieving close tip clearances is to use coatings on compressor shrouds which are easily abraded (cut) away when the airfoil comes in contact with it. In our next generation engine systems, the temperature will be reaching temperatures in the high pressure compressor that traditional coating materials cannot tolerate. The objective of this program will be to develop a coating material or class of materials which will be capable of tolerating the increasingly hostile environment.

Phase I: Assess potential materials or material classes which appear to possess the capabilities and characteristics desirable in abradable systems. The survey shall include factors such as compatibility with titanium based alloys (mechanical, chemical, and metallurgical). abradability by thin titanium airfoils, thermal stability/survivability (temperature at/about 1100oF), and compatibility with commonly found engine fluids. Specimens of the selected material(s) will be fabricated and evaluated for their abradability and adhesion to the substrate. Test blade material removal will be assessed. Testing should be conducted at both room temperature and 1000F.

Phase II: Develop and demonstrate prototype tooling capable of coating full size compressor shrouds. Develop preliminary process specifications. Conduct dynamic adhesion and abrasion tests on full size compressor shrouds at room and elevated temperatures. Evaluate and assess materials and process capabilities and limitations.

A91-178 TITLE: Advanced Fabrication of Powder Metallurgy (PM) Components

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate an innovative approach for the production rate fabrication of net shape or near-net shape PM materials.

DESCRIPTION: The aviation industry is increasingly being drawn toward the use of titanium, nickel, and aluminum PM materials. The primary reason being that powder metallurgy offers a wide range of tailorable characteristics that can be exploited such as fatigue resistance, high strength, and alloying potential. One of the biggest limitations of PM is in the fabrication of final form components. Turbine engine components must be either fully machined from a billet or forged to a rough shape and then finish machined. This is obviously expensive. It is the objective of this project to develop an innovative, economical approach for the fabrication of net shape or near-net shape titanium, aluminum, or nickel-base turbine engine components of moderate complexity.

Phase I: Develop preliminary tooling, processing specifications, and fabrication modeling required for the production rate fabrication of a generic component shape. The demonstration component should be of sufficient complexity to demonstrate the formability of an axi-symmetric structure with thin and thick sections. Post process evaluation will be conducted to assess the quality of the fabricated test articles with respect to fill, porosity, and mechanical properties.

Phase II: Refine the tooling and processing parameters defined in Phase I. Demonstrate the process capabilities through the fabrication of complex configuration components such as a bladed ring or component housing. Evaluate process capabilities and evaluate mechanical/metallurgical properties.

A91-179 TITLE: High Performance Braided Structures Investigation

CATEGORY: Advanced Development

OBJECTIVE: Improve the geometric and material fiber content tailorability of advanced fibrous composite braided structures for use in primary airframe designs.

DESCRIPTION: Advanced composite structures rely on simple woven or unidirectional fibrous material forms in their design. Employing some of the more advanced, tailorable technologies into the design and fabrication of primary airframe structures will both improve performance and reduce cost by an order of magnitude. Braided fibrous composite structures are efficient in terms of both cost and performance, but are limited in several ways. Improvements in or a change from hoop braiding will allow increased preform cross-axis (diameter) size. Nonsymmetrical designs may also be possible. Damage to high modulus graphite fibers during braiding constrains the geometric complexity/ tailorability of the design. Inability of the braiding equipment to accommodate/incorporate more than one fiber type (graphite, aramid, glass) uniformly into the preform limits structural efficiency.

Phase I: Identification of future braided material preform requirements of airframe manufacturers, and limitations in the current braiding process/machinery will highlight specific technology needs. Technology survey/demonstration and requirements identification will establish relationships between fiber suppliers, braided preform manufacturers, and prime contractors.

Phase II: Once a specific opportunity or need has been established, specific braiding technology processes and machinery will be prototyped and demonstrated. Various approaches will be evaluated as to their response to solving the technology need, and which are best suited for more advanced development.

A91-180 TITLE: Integrating Artificial Intelligence into the Aviation Simulation Network

CATEGORY: Exploratory Development

OBJECTIVE: Develop software to integrate Artificial Intelligence (AI) software into the Army Aviation Simulation Network (AIRNET) to prove advanced AI based helicopter pilotage concepts.

DESCRIPTION: With the increased complexity of today's helicopter pilotage systems, cognitive decision aiding has become a tool to reduce pilot workload and overload. With the increased cost of development of a new Army system, man in the loop simulation networks have become a cost effective way to analyze and prove potential increases in wartime fighting capability of the combat pilot. Currently, the Army is developing AI software to reduce pilot workload and increase pilot effectiveness. The Army has no effective means of integrating AI software into AIRNET at Ft. Rucker, Alabama. AIRNET provides a means of measuring unit operational effectiveness.

Phase I: Investigate the feasibility of integrating the AI software into AIRNET. Determine the hardware and software needed to integrate into AIRNET. Develop a software development plan test and evaluation plan and generate a final report.

Phase II: Design the hardware/software proposed in phase one to be integrated into AIRNET. Implement the software development plan and the test and evaluation plan. Perform a demonstration of the application hardware and software, deliver final report, source code and hardware.

A91-181 TITLE: High Strength Thermoplastic Materials for Aircraft Components

CATEGORY: Exploratory Development

OBJECTIVE: To develop high temperature, high strength thermoplastic materials and production-oriented fabrication processes for production of aircraft-quality components and subcomponents.

DESCRIPTION: Thermoplastic materials are becoming increasingly attractive in the aviation industry because of their improving mechanical property characteristics and lower manufacturing costs relative to traditional materials. Due to the ever increasing cost of manufacturing aircraft components, emphasis must be placed on the development of economic fabrication processes while maintaining component strength and durability.

Phase I: Conduct a survey of thermoplastic or reinforced thermoplastic materials which yield the highest potential for good processability and high strength. Fabrication of a generic component shape will be performed using the selected material(s), a preliminary processing specification, and prototype tooling. The generic component shape should be similar in size and shape to an aircraft accessory housing. Emphasis shall be placed on economic net shape/near net shape fabrication processes. The fabricated test articles will be tested and evaluated to determine the materials mechanical properties, processability, and formability.

Phase II: Further refine the materials and fabrication processes defined in Phase I. Emphasis will be placed on the development of actual production-oriented manufacturing processes and process specification development. Enhancements will be made to the materials, tooling, and processes which will allow achievement of full material strength durability and cost effectiveness. Demonstration components to be fabricated shall be an aircraft accessory housing to be determined later.

A91-182 TITLE: Directed Energy Damage Assessment and Repair

CATEGORY: Exploratory Development

OBJECTIVE: Develop battle damage inspection, assessment, and repair techniques for aircraft components damaged by directed energy weapons, i.e., high energy laser (HEL), high power microwave

(HPMW), etc.

DESCRIPTION: The increased threat of directed energy weapons (DEW) being used on the future battlefield requires a more detailed understanding of the vulnerability of aircraft components/materials and DEW peculiar damage modes and effects. The Army is particularly interested in HEL and HPMW damage in terms of material/performance degradation, and requirements for battle damage inspection, assessment and repair techniques.

Phase I: Develop test plan for candidate helicopter components/ material for DEW test to determine damage modes and effects. Develop expedient battle damage inspection, assessment and repair techniques for HEL damage. Analyze effects of HEL on currently available HEL damaged helicopter structural and dynamic components and validate expedient battle damage inspection, assessment and repair techniques. Determine requirement for special inspection/test equipment to assess damage.

Phase II: Conduct DEW test on candidate helicopter components (as defined in Phase I) to provide DEW damaged samples of current and advanced helicopter components and materials. Analyze damaged components, i.e., conduct structural loads and material properties tests to verify predicted modes and effects. Demonstrate expedient battle damage inspection, assessment, and repair of DEW damage components.

A91-183 TITLE: Composite Material Treatments to Improve Abrasion Resistance

CATEGORY: Exploratory Development

OBJECTIVE: To develop processes, treatments or coatings to improve abrasion resistance of composite materials used for helicopter external surfaces.

DESCRIPTION: Composite materials are seeing increasing use in the construction of helicopter rotor blades, airframe primary structure and airframe secondary structure. Erosion of the matrix material in composites proves to be a severe problem in rotor blades and to a lesser extent with other portions of the structure. This problem is more severe in helicopters than for fixed wing aircraft because they operate from unimproved landing areas and close to the ground. Firing of rocket and missiles creates an erosion problem which is accompanied by significant thermal effects. Presently available treatments for improving the erosion resistance of rotor blades include coatings and tapes which can be added after the primary manufacturing steps. These are effective for limited erosion exposure, but are really "bandaid" solutions.

Phase I: Investigate methods of improving the abrasion resistance of composite materials that could be incorporated as an integral part of the manufacturing process to provide a life- long improvement. Methods that should be considered include: use of alternate resin systems; treatments that correspond to heat treating, annealing or infusion techniques in metals; coatings that would have a long lifetime and would be best applied in a factory or depot setting. Evaluate proposed approaches in terms of cost/benefit ratio as compared to present add-on systems. Select most promising systems for follow-on work.

Phase II: Prepare specimens according to methods developed in Phase I. Test for water, sand and rocket motor blast erosion resistance. The Government could provide assistance in arranging use of test facilities needed, but not otherwise available to the contractor.

A91-184 TITLE: Full Authority Automatic Flight Control For Adverse Combat Situations

CATEGORY: Exploratory Development

OBJECTIVE: Develop rotorcraft automatic flight control system that permits automatic return-to-base, hover, and/or landing.

DESCRIPTION: The reality of both adverse battlefield environments (e.g., blowing sand, snow and/or smoke) and combat casualties (e.g., wounded pilot/co-pilot) suggest the prudency of an automated means to control the aircraft. In the event of an incapacitated crew and/or loss of external horizon visibility, a profoundly advantageous safety feature for vehicle and crew protection would provide automatic control of the aircraft for return-to-base, hover or horizontal fight hold, and/or approach to landing. Such automated capability may require vehicle position and airspeed sensing devices beyond current accuracy and/or robustness.

Phase I: Review control mechanization concepts which will allow as one of the modes of a digital automatic flight control system, an automated land or get home mode which can be entered automatically without pilot intervention.

Phase II: Provide a detailed design of the Phase I concept for a contractor selected helicopter.

A91-185 TITLE: Covert Terrain/Obstacle Avoidance System for Helicopters

CATEGORY: Exploratory Development

OBJECTIVE: To assess current and emerging covert Terrain/Obstacle Avoidance technology and identify candidate systems for advanced development.

DESCRIPTION: Army helicopters are currently conducting extensive low-level high-speed operations during the hours of darkness. The avoidance of terrain and obstacles is accomplished solely through the use of night vision devices such as night vision goggles and Forward Looking Infra-Red (FLIR) systems. Pilot visual acuity and depth perception using these systems is poor, and high speed operations often result in obstacles not being seen or being detected too late for the pilot to react. The current solution is to fly at slower airspeeds and higher altitudes, resulting in longer mission times and increased exposure to enemy detection. In order to fully utilize the capabilities of today's aircraft, the pilot requires a system to assist in detection, location, and avoidance of terrain and obstacles. Ideally, this system should not increase aircraft signature. The purpose of this program is to study and evaluate current and evolving terrain/obstacle avoidance technologies to determine mid-term (12 to 18 months) and far-term (2 to 4 years) solutions.

Phase I: The proposer will explore current and evolving technologies and analyze the advantages and disadvantages of each in terms of effectiveness, cost, weight, covertness (passive vs active), complexity, and development time lines. The result of Phase I will be a report outlining the research and itemizing the tradeoffs and recommendations.

Phase II: Provide the specification requirements and detail design for follow-on advanced technology demonstration of a specific system or systems.

A91-186 TITLE: Electrostatic Fuel Injector

CATEGORY: Exploratory Development

OBJECTIVE: To develop a fuel injector for Army turboshaft engines which utilizes the principles of electrostatic repulsion to enhance the spray characteristics.

DESCRIPTION: As turboshaft engine cycle temperatures increase, so does the need for improved fuel

atomization techniques. Conventional pressure atomizers are unacceptable for advanced turboshaft engines. Likewise, state-of-the-art airblast atomizers appear to be reaching the limits of their capabilities in terms of turndown ratio and atomization quality at low power. These problems are further exacerbated by the DOD-wide conversion from JP4/JP5 to the more viscous and less volatile JP8. For these reasons, innovative designs, such as the electrostatic fuel injector, must be advanced. The concept of using electrostatic repulsive forces to improve the spray quality of pesticides and paints has been proven. However, no significant efforts have been conducted using aviation fuels, such as JP8. Electrostatic fuel injection has the potential to yield significant improvements in combustor stability and operability. By artificially inducing these repulsive forces on the fuel, spray quality can be actively controlled at all power settings.

Phase I: Investigate the feasibility of using electrostatic repulsive forces to enhance fuel spray quality, as compared to comparable production fuel injectors. Specific issues of concern are safety, level of improvement, complexity, effect on combustor operability, etc. Phase I should also outline a viable system.

Phase II: Perform a thorough system design using any typical Army turboshaft engine as a baseline. Demonstrate the concept using appropriate rig tests.

A91-187 TITLE: Electrically Conductive Composite Material Repair Techniques

CATEGORY: Exploratory Development

OBJECTIVE: To develop repair techniques for helicopter structure made of composite materials to restore the integrity of the structure and the electrical continuity of the aircraft surface.

DESCRIPTION: Composite materials are seeing increasing use in the construction of helicopter rotor blades, airframe primary structure and airframe secondary structure. Non-conductive composite materials used on the helicopter's external surface must be treated with a conductive medium to dissipate lightning and to reduce radar signature. Field repair techniques have been demonstrated which restore the structural integrity of secondary structure made of thermoset materials. Satisfactory structural repairs of thermoplastic have not been demonstrated. No consideration has been given to reestablishing electrical continuity across the repair.

Phase I: Review existing methods used during aircraft fabrication to establish electrical continuity. Develop a list
of proposed methods for establishing electrical continuity across repairs for electrically conducive treatments now in use. Perform a feasibility investigation of the most promising of the proposed methods. Develop criteria and test methods for specimen tests of repair techniques.

Phase II: Develop and demonstrate the most promising repair methods using specimens provided by the Aviation Applied Technology Directorate. The Government could provide assistance in arranging use of test facilities needed, but not otherwise available to the contractor.

A91-188 TITLE: Real Time Associate System Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop Real Time Capability for cooperating knowledge based systems.

DESCRIPTION: With the emergence of associate systems technology as a major element of Artificial Intelligence, there is a need for real time execution. Knowledge based systems are currently not designed to operate in real time. Real time execution is an even greater challenge for associate systems with cooperating knowledge based systems. Methods such as shared memory techniques, improved search

strategies, dynamic task allocation, language modification, operating systems, and/or applications software attempt to provide real time execution. While these provide some performance payoffs, new methods must be developed to provide superior solutions.

Phase I: Identify an appropriate application(s) containing cooperating knowledge based systems. Develop a conceptual design of a real time system executive to provide real time capability for the application. Provide a hardware/software development plan, test and evaluation plan, and provide a final report.

Phase II: Implement hardware/software development plan. Test and evaluate the system. Demonstrate the application identified in phase I. Deliver a final report.

A91-189 TITLE: Directed Energy Technology for Helicopters (DETH)

CATEGORY: Exploratory Development

OBJECTIVE: Develop an innovative directed energy weapon concept applicable to Army Aviation for increased system effectiveness through improved accuracy, lethality, and stowed kills with a reduction in exposure time over conventional weapons. The intent is to not limit the possibilities to a specific technology such as laser based systems.

DESCRIPTION: Directed energy weapons are considered to have potential for providing essentially unlimited firepower over payload limited conventional weapons. Application of directed energy technologies has been primarily limited to ground vehicles because of the associated size and weight. Directed energy systems (low to high power lasers, high power microwave, particle beam, electromagnetic pulse, magneto hydrodynamics, etc.) would complement a conventional weapons suite on Army rotorcraft by providing a capability for defeating threat target acquisition systems and other electronic systems and possibly initiate the fuze of stowed threat weapons. Risk areas include improving energy conversion efficiencies, thus reducing the weight and size of onboard support equipment, as well as hardening the host aircraft and surrounding friendly aircraft from the effects of such a system.

Phase I: Based on the Contractor's unique capability and the approach being perceived to have realistic potential for an aviation application, they shall further develop the proposed directed energy system approach and analyze its effectiveness. The analysis shall include the effects of the helicopter operational environment on the weapon system, extended range capabilities, performance probabilities, payload limitations and component maturity assessments. The system shall be capable of defeating threat ground and airborne systems with the end result ranging from mission abort to forced landing to attrition kill.

Phase II: The system design shall be completed in sufficient detail to support fabrication of hardware needed for a laboratory demonstration. Subsequently, the system capabilities shall be demonstrated to the extent possible in a laboratory environment. The purpose of this phase is to show that the new and innovative system approach has the potential for meeting or exceeding conceptual expectations prior to large capital commitments being made for advanced develop efforts. This may also be considered a maturation phase.

A91-190 TITLE: High Temperature, High Speed Brush Seals

CATEGORY: Exploratory Development

OBJECTIVE: To develop an advanced brush seal system capable of operating at the high temperature and speeds found in advanced turbine engines.

DESCRIPTION: Brush seals are unique in their ability to effectively control and regulate flow rates of low density fluids such as air. Next generation gas turbine engine systems, in order to achieve performance objectives, will require the use of brush seals which are capable of operating at high speeds and elevated temperatures. Current technology brush seals cannot survive these conditions.

Phase I: Develop a brush seal system which is capable of operating at temperatures about 1450oF and at tip speeds of at least 1450 ft/sec. Development activities should include exploitations of advanced materials, modeling techniques, and fabrication processes. A sub-scale durability evaluation should also be conducted to assess capabilities of candidate materials and seal configurations.

Phase II: Using the processes and materials defined in Phase I, fabricate a full size brush seal capable of achieving the required temperatures and speeds. Test the fabricated seal assembly in a simulated turbine engine environment and assess its mechanical durability and performance.

A91-191 TITLE: Compact, Light-Weight Heat Exchanger

CATEGORY: Exploratory Development

OBJECTIVE: Develop compact, light-weight heat exchangers for aircraft/helicopter application.

DESCRIPTION: In turboshaft gas turbine engines a significant amount of energy is wasted by being dumped overboard in the exhaust. Attempts to capture this wasted energy in a recuperated cycle have been hampered by the size, weight, manufacturing complexity, and cost of present day heat exchangers. Innovative heat exchanger concepts are needed which overcome today's technology limitations.

Phase I: Develop new concepts for heat exchangers which are small, light weight, low cost and easy to manufacture. Analytically predict the heat exchanger performance characteristics and substantiate manufacturing and cost advantages over present day technology units.

Phase II: Demonstrate the construction technique and verify the performance predictions for the heat exchanger.

A91-192 TITLE: Electrostatic Enhancement of Fine Particle Removal in Axial Inlet Particle Separators (IPS)

CATEGORY: Exploratory/Advanced Development

OBJECTIVE: Develop an electrostatic particle separator concept capable of enhancing the fine particle separation of a T800-type inertial IPS.

DESCRIPTION: Current axial IPS's, like in the T800, are very efficient at the removal of the very erosive large particles but fall short on the removal of fine particles which can cause substantial distress to hot section components in gas turbine engines. Electrostatic particle separators have long been considered as a good candidate for fine particle separation but electrostatic separators tend to collect the fine dust which reduces efficiency substantially. This effort will concentrate on trying to develop an electrostatic device which can enhance inertial IPS's without collecting fine dust (i.e., self cleaning). The device could be built to mount in front of the IPS but it would be preferable to incorporate the device into the design of an IPS without affecting the flow path or the IPS envelope.

Phase I: Develop concepts for an electrostatic fine particle separator to enhance current IPS designs. Determine the feasibility of the concepts to enhance fine particle separation while not effecting the separator's ability to remove larger particles. Other factors to be considered when evaluating the concepts should include: size, weight, power requirements, reliability, ability to be anti-iced, ability to be compatible with current IPS materials and coatings, and observability.

Phase II: Design and fabricate a model electrostatic IPS. Test the electrostatic IPS to

determine the efficiency improvement in the removal of AC Fine sand (8 micron average particle diameter) and verify that it doesn't degrade the efficiency for C-Spec sand (200 micron mean diameter). Develop a design guide for electrostatic IPS's. The goal for this program is to achieve greater than 90% efficiency at AC Fine sand with minimal impact on size and weight.

A91-193 TITLE: Innovative Turbine Cooling Concept

CATEGORY: Exploratory Development

OBJECTIVE: To evaluate innovative turbine cooling concepts which can potentially decrease cooling air requirements and/or permit higher turbine operating temperatures.

DESCRIPTION: Future small turboshaft engines (airflow less than or equal to 25 lb/sec) will require significant increases in turbine inlet temperatures (nozzle gas temperatures over 3000oF) to meet engine cycle goals. To maintain life requirements, advances in cooling technology will need to be achieved in conjunction with the advanced materials development. Typical cooling configurations in use today are enhanced internal convective cooling within the main body of the airfoil and external film cooling at or near the leading and trailing edges. These configurations will not provide the operating temperatures and low cooling air requirements which will be necessary in future engines.

Phase I: Identify and evaluate new and innovative turbine cooling concepts. Several geometries should be taken into consideration. Then, using a baseline which is representative of current technology level, select two to four cooling geometries which could potentially provide a cooling effectiveness level greater than or equal to that of the baseline to be further pursued. Also, the Army's operational environment (in particular, sand and dust) shall not be ignored to ensure blockage of cooling passages is prevented.

Phase II: Preliminary evaluation of those cooling geometries warranting further investigation shall be performed (i.e., large scale flow visualization, wind tunnel testing) to verify improvement potential. Complete definition of heat transfer characteristics of the most promising cooling configuration selected (i.e., 2-D heat transfer rig testing with full simulation of advanced turboshaft engine conditions).

A91-194 TITLE: CASE Tools Support for Common Avionics Module Development

CATEGORY: Exploratory Development

OBJECTIVE: Identify/Develop a robust set of CASE tools for the development of a common suite of avionics software modules.

DESCRIPTION: Current and future Army aircraft are increasingly dependent on computer hardware and software to perform mission/life critical functions. Accordingly, these computer systems are consuming much higher percentages of the total vehicle costs. Recently, DoD has advocated the usage of common modules as an attempt to control the skyrocketing costs of avionics software development. The common avionics approach can be fully utilized if a robust set of CASE tools can be identified or developed to support module development. The CASE tools should be able to support requirements definition, detail design, source code development, traceability of code to requirements, unit test, validation and verification, possible integration testing, and source code/ documentation maintenance.

Phase I: Identify a set of CASE tools which can support DoD and industry standards with respect to software development methodology, detailed design languages, programming languages, and JIAWG standards.

Phase II: Develop/Customize the set of tools for use in common avionics module development.

A91-195 TITLE: Engine/Rotor/Auxiliary Thrust/Stability Integration System

CATEGORY: Exploratory Development

OBJECTIVE: Develop a scheme whereby the thrust of the engine can be diverted from the rotor to an internal/external fan (with possible augmentation/burning) whose flow can be diverted to overcome rotor torque and provide added thrust for extra forward velocity. Rotor slowing may be necessary as speed is added.

DESCRIPTION: The rotor is an extremely efficient device when used in forward thrust as its low disk loading yields high thrust per horsepower from the forward tilted vector. Forward thrust can be had from a propeller; however, because of its high disk loading, it will require more horsepower than the tilted rotor and will weigh more. However, the helicopter is limited in speed because of the speed of the advancing rotor and can be made to fly faster if the rotor is slowed, and additional thrust is provided by a pushing device, rather than the rotor. The power required to cancel the torque of the rotor, (approximately 10% at hover) can be used both to provide added speed and anti-torque by vectoring this thrust and possibly augmenting it, using an internal external fan or some such device. It is desirable that this entire system be integrated to accomplish this task. At some cost in power and weight it would gain speed and solve the anti-torque problem.

Phase I: Design an integrated system that takes all of these factors into account.

Phase II: Prepare drawings and design details, estimated performance and weights reports for evaluation of its practicality.

CONSTRUCTION ENGINEERNG RESEARCH LABORATORY

A91-196 TITLE: Active Control of Building Structures Using Shape Memory Alloys

CATEGORY: Exploratory Development

OBJECTIVE: Develop structural engineering technologies that apply shape memory alloys as controlled stiffener devices in seismically vulnerable steel and reinforced concrete frame structures. Equipment developed in Phase II would be installed in a laboratory test structure and observed for responses to simulated seismic events.

DESCRIPTION: Materials researchers are now developing "shape memory alloys" that have large expansion and contraction responses to applications of electrical currents. Other researchers have begun developing motion sensors and control systems that may be used to actuate various active control mechanisms for structures in seismically active regions. It may be possible to combine the available control systems with devices made of shape memory alloys, wherein the devices can be used to vary structural element stiffnesses, thereby altering structural responses to dynamic loads.

Phase I: Analyze current state-of-the-art in shape memory alloys with emphasis on stress-strain behaviors, expansion-contraction characteristics, electrical requirements, response mechanisms, service life (including fatigue), cost, and fabrication capabilities. Develop concept designs for actuators made of shape memory alloys.

Phase II: Fabricate prototype shape memory alloy actuators and mate the actuators to a laboratory-level sensor-control system. Install the resulting control devices on a test structure. Subject the test structure to simulated seismic ground motions on earthquake simulator at USACERL. Analyze results of tests for field use.

A91-197 TITLE: Neural Networks for Predictive Heating Ventilation Air Conditioning (HVAC) Controls

CATEGORY: Basic Research

OBJECTIVE: The goal of this research is to develop a neural network capable of analyzing spatiotemporal patterns in parameters pertinent to determining building loads. The required network should be practical for use in an actual building HVAC control system.

DESCRIPTION: HVAC control strategies have been extensively analyzed to reduce energy consumption and/or costs. Strategies have been developed that, given knowledge of the future, can reduce energy costs by shifting peak loads, etc. If a practical method could be determined for predicting building loads (based on real-time data regarding weather conditions, occupancy, etc.), many such strategies could be tested for practical application.

Phase I: Tasks for Phase I will be to determine which time-variant parameters affect building loads. After this determination is made, it will be ascertained what quantities can be measured in a building either directly or indirectly indicate these parameters. Given these quantities, a neural network simulation will be developed.

Phase II: At the end of Phase II, the simulation developed in Phase I will become fully operational neural network, capable of making predictions in real time for a suitable prediction period. The predictive capabilities will be field tested for various climate and building types.

A91-198 TITLE: Environmental Knowledge-Base Model for Facilities Design and Construction

CATEGORY: Basic Research

OBJECTIVE: To develop and field test a model of environmental characteristics/attributes for inclusion in the decision process involved in facility design, construction, and operation activities. If this concept proves to be feasible, an environmental attributes Knowledge-Based Model can be developed to support facilities design, construction and operation.

DESCRIPTION: Decisions involving facility design, selection of building materials and systems, construction planning, and operation are based primarily on economics and in-place performance. Environmentally-related characteristics are generally not evident in the technical, pricing, or planning data that is currently available. Therefore, the environmental effects of building materials, construction activities and long-term facility operations are not directly considered in decision processes. Data must be made available to design professionals, construction planners, and facility managers to indicate environmentally-related characteristics and minimize adverse long-term affects.

Phase I: Decisions involving facility design, construction, and operation decision making by providing environmentally related data. This model should represent environmental characteristics/attributes (such as energy and resource requirements for manufacture or construction by-product or waster generation, potential for reuse of recycle, disposal considerations, personal exposure, etc.) that would be applicable throughout the facility life-cycle. Describe how this data will be presented in the decision processes involved in each life-cycle phase. Phase I work must also address the availability of data to support a Knowledge Base, sources of data, and considerations for maintaining data.

Phase II: Initiation of Phase II depends upon successful completion of Phase I. for Phase II, develop a prototype automated Environmental Knowledge Based Model for Facilities Design and Construction. This prototype will consist of refinement and further development of the concept

developed in Phase I, sufficiently complete in Knowledge Base structure and data content to ensure useability and maintainability.

A91-199 TITLE: Geo-based Environmental Audit Support System

CATEGORY: Exploratory Development

OBJECTIVE: Develop a Geo-based Environmental Audit Support System for DOD Underground Storage Tank Program management, compliance and decision support.

DESCRIPTION: Environmental compliance programs such as the Underground Storage Tank (UST) Program impose tremendous reporting and decision-making requirements on DOD environmental managers. Maps, photographs, field notes, engineering drawings, laboratory reports, correspondence, and other technical and administrative documents are all necessary for environmental compliance and decision support. These are, however, typically not well organized or easily retrievable for environmental audit support. The proposed development effort will provide a well-integrated mapping and information management and retrieval system for environmental audit support, particularly in the area of UST program management.

Phase I: Phase I will result in a conceptual system design capable for graphic and non-graphic data management and retrieval of UST data from within a mapping environment.

Phase II: Phase II will result in a prototype system which will provide well-integrated, comprehensive, and easy-to-use mapping and data management/data retrieval capabilities for UST program management and compliance. This prototype system and associated specifications will be suitable for adoption and customization by any Department of Defense installation faced with UST regulatory program requirements.

ENGINEER TOPOGRAPHIC LABORATORIES

A91-200 TITLE: Capability to Assess/Quantify Improvements in Operational Performance Versus a Change in Data Base Characteristics

CATEGORY: Exploratory Development

OBJECTIVE: Develop a capability to assess the marginal performance improvement of a military unit given a change in terrain data base characteristics.

DESCRIPTION: A major problem faced by the Army when defining future digital topographic requirements is a lack of quantitative measures which can be used as a basis for decision making. An historical example illustrates the need. Development of Pershing II's radar correlation unit required that system designers understand the missile's overall error budget. This knowledge of system errors levied certain requirements on the accuracy of the DTD(Digital Terrain Data) supporting the missile's terminal guidance. Assessing military units provides a larger challenge in that units are not as predictable as mechanical systems and performance characteristics are not as well understood as are the laws of physics.

The Army is developing a requirement for higher resolution DTD than is now being routinely developed by the Defense Mapping Agency to support future operational needs. A modeling capability is needed to assess the marginal operational performance gain of the Army given an increase in accuracy, resolution, or content of supporting DTD.

Phase I: Review Army unit models currently being used to determine terrain data densities being utilized and analyze their sensitivity to terrain data components in predicting unit operational

efficiency. Recommend improved methods of quantifying and evaluating terrain data's contribution to unit efficiency.

Phase II: Develop one of the recommended methods for quantifying and evaluating terrain data as a contributing component of unit efficiency.

A91-201 TITLE: Three Dimensional Modeling Station

CATEGORY: Exploratory Development

OBJECTIVE: Develop an effective approach to create and populate a three dimensional model library for use in simulators, training devices, and mission rehearsal systems.

DESCRIPTION: The use of simulators and image generators in the Army for a variety of tasks, including training and mission rehearsal is growing rapidly. One common thread to these systems is the need for digital topographic data. Standard data sets are becoming increasingly available from the Defense Mapping Agency that describe the relief (elevation data), and the location and description of features (planimetric data). With the rapid growth anticipated in 3D representations of these data, a need exists to standardize and share the ability to generate models of the feature data, for placement into the scenes.

Phase I: Study existing modelling capabilities in the community and those emerging in related fields, particularly on the microcomputer level. Consideration should be given to modeling methods (i.e. facets versus graphic primitives), texture, and interchange formats from existing model libraries. The study should culminate in a recommended design approach for a modeling station suitable to create, import, and maintain a model library of features found in DMA's Interim Terrain Data.

Phase II: Assemble the modeling station and populate a data base with models of all suitable features defined in DMA's Interim Terrain Data, at appropriate levels of detail.

A91-202 TITLE: Landform Identification from Elevation Data Using Neural Nets

CATEGORY: Exploratory Development

OBJECTIVE: Use neural nets to develop method for identifying such landforms as hills, valleys, and ridges from Digital Terrain Elevation Data (DTED).

DESCRIPTION: One of the missing links in developing sophisticated automated terrain reasoning systems is the gap between the semantic description of military doctrine (which uses terms such as hill or valley) and the topographic data base which typically consist of an elevation grid with overlays detailing vegetation, soil types, etc. Neural nets have the potential to be trained to identify landforms of varying size and orientation and thus provide the link between the semantic description and the terrain data base. This research differs from previous research in using elevation data rather than aerial photographs as the input to the system.

Phase I: Determine basic feasibility by developing training sets of one specific landform and then testing the system to determine its robustness in extracting the same type of landform from test data.

Phase II: Extend the system to handle a variety of landforms and develop an interface between the neural net and an expert system.

A91-203 TITLE: Development of Formatting Utilities for Project 2851 Standard Simulator Database (SSDB) Output

CATEGORY: Exploratory development

OBJECTIVE: Develop database formatting utilities to allow import of Project 2851 SSDB Standard Interchange Format (SIF) databases to existing simulation systems.

DESCRIPTION: Project 2851 is a tri-service program designed to develop a Standard Simulator Data Base and associated transformation software necessary to provide a wide range of real-time image generation/simulation systems with consistent, compatible database products. Project 2851 plans to provide a Standard Interchange Format (SIF) as an input/output format to the simulation community both input and output software is required to convert the SSDB/SIF and simulator formats so that existing computer image generation/simulator systems can utilize and contribute to the P2851 database. Future efforts would focus on transforming this capability to high-end commercial-off-the-shelf (COTS) workstations with open-architectures.

Phase I: The first phase of this project will be a six month effort to: 1. Analyze the database structure of the SSDB/SIF format, and 2. Investigate the feasibility of developing standard formatting algorithms that would allow for the interchange of SSDB/SIF data with existing simulation systems.

Phase II: Under the second phase of the project, the contractor shall develop a group of standard formatting algorithms to allow the interchange of P2851 SIF data with a suite of existing simulation systems. These systems will include, but not be limited to, Unix-based systems with "X-Windows" graphic user interfaces. The government will furnish as GFE, the software used to format P2851 Generic Transformed Data Base (GTDB) data for the in-houseUnix-Based platform and if necessary, the Boeing CIG system.

A91-204 TITLE: Text Identification, Extraction, and Manipulation Using Raster Map Images

CATEGORY: Exploratory Development

OBJECTIVE: Provide algorithms and software to identify, extract and manipulate text using raster map images.

DESCRIPTION: A potential drawback to the use of digital raster map products is limited text manipulation capabilities. Although not yet validated as a firm requirement, members of the Army aviation community and the Engineer Battalions (Topographic) have indicated that digital map background displays would be easier to use if key text were rotated so that it is always read right-side-up regardless of the orientation of the map.

To accomplish this task, text must first be identified and extracted from the raster map image. In order to preserve the quality of the non-text image, the areas beneath the lettering should be filled in with the background color and linear features interrupted by the lettering should be connected. The extracted text should be available for placement on the rotated map. This can be done with varying levels of sophistication, from simple rotation of the raster text in fixed increments to conversion of the text to ASCII form and storage of the text along with its font, type size, type style, and the coordinates of the related feature in a separate file.

Phase I: Analyze requirements for rotated map text and evaluate algorithms for identifying, extracting and manipulating text using raster map images.

Phase II: Select most promising algorithms identified in Phase I and develop software to identify and extract raster map text, as well as display rotated text.

A91-205 TITLE: Urban Feature Digital Data Base

CATEGORY: Exploratory Development

OBJECTIVE: This effort is to design a feature data base over urban terrain and develop ways to produce the data base cost effectively. This effort does not address elevation or wire frame data extraction over urban areas.

DESCRIPTION: Urban military engagements are becoming much more common in modern warfare. Whether its a military operation like Panama, a rebel insurrection as happened in the Philippines and Romania, or the rescue of hostages, planning information about urban terrain is becoming increasingly important. For the purpose of this effort it can be assumed that an elevation model or wire frame model is available. The focus is on feature data emphasizing the man made features in the urban area.

Phase I: Design a feature data set for urban terrain. This should include feature types and attributes. Each individual man-made feature need not be in the data base. For the purpose of reducing production costs, man-made features may be aggregated if this can be done in some meaningful way. Prepare a design of the hardware, software, and procedures required to produce the data in a cost effective manner.

Phase II: Implement a prototype capability to produce urban feature digital data base. Use this capability to produce at least one sample data set over an urban area.

WATERWAYS EXPERIMENT STATION

A91-206 TITLE: Generic Mixed Mode Integrated Circuit for Data Conditioning

CATEGORY: Exploratory Development

OBJECTIVE: Develop a generic building block which contains all of the signal conditioning and digital electronics necessary to interface a transducer to an analog-to-digital converter.

DESCRIPTION: The generic building block integrated circuit should contain all of the electronics necessary to allow designers to easily build a single channel, digitally controlled, signal conditioning unit. The device should be able to be controlled from either an 8- or 16- bit microcontroller and have the following features: a programmable gain instrumentation amplifier, an auto-zero circuit to null out offset voltages, a means of digitally calibrating the system, an anti-aliasing filter, and a low output impedance buffer. The device should: (1) operate from either a single or dual power supply, (2) provide programmable gain from 1 to 1024, (3) have a minimum bandwidth of 150 KHz, (4) support sampling rates up to 1 MHz, and (5) have a signal to noise ratio and dynamic range to provide for 12-bit resolution. It is anticipated that this device will be used primarily in battery powered systems, so it should be designed to consume as little power as possible and be able to be powered down when not in use.

Phase I: The first step should be to perform a feasibility study to determine if all of these features can be included on one integrated circuit. It may not be feasible to get all of the necessary electronics on one integrated circuit, for example external digital-to-analog converters may be required. At the end of this first step, a design review with Army sponsor will be made before proceeding. At the conclusion of the design review, the second step will be to design, layout, and simulate an Application Specific Integrated Circuit (ASIC) using Computer Aided Design Tools (CAD) and furnish the design and simulation to the Army sponsor for final review.

Phase II: Finalize the approved design and submit it to a silicon foundry for fabrication. Test and verify a number of prototypes and furnish the results and 10 packaged devices to the Army sponsor for evaluation. If approved, provide 500 units in plastic surface mount packages for prototype

production.

ARMY RESEARCH INSTITUTE

A91-207 TITLE: Reserve Force Structure Planning Model

CATEGORY: Exploratory Development

OBJECTIVE: A Reserve Force Structure Planning Model is required to economically integrate this component in the Congressionally mandated concept of Total Army. Such a model will provide users with manpower cost and force structure implications of changes in personnel policies, particularly those involving changes in current or future compensation elements.

DESCRIPTION: The recent deployment of a substantial number of Reserve units in Operation Desert Shield demonstrates the importance of the Total Army concept. While a series of recent efforts have been directed towards providing better retention, cost, and force structure models of enlisted and officer soldiers, similar models of the Reserve component are conspicuous by their absence.

Phase I: Phase I of this research requires development of a theoretical framework of the U.S. Army Select Reserve retention intention model. The economic theories of moonlighting and compensated leisure may be adapted for empirical specification. Defense Manpower Data Center's 1985 Survey of Reserve Component database of officers and enlisted personnel (with information on military and civilian earnings) in the Army would be available for estimating these models.

Phase II: Phase II of this SBIR program requires integrating the retention intention parameter estimates from Phase I, and Reserve component manpower cost data from ARI's Army Manpower Cost System (AMCOS), into a prototype Reserve Force Structure Planning Model.

A91-208 TITLE: Sampling Combat Conditions for Simulation Fidelity

CATEGORY: Exploratory Development

OBJECTIVE: To establish methods for identifying and sampling combat conditions for inclusion in simulation.

DESCRIPTION: Realistic combat training scenarios are needed for use in Combat Training Centers (CTC), combined arms simulations and embedded training. Because all potential combat scenarios for a mission area cannot be included for training, methods for sampling combat conditions for training scenario design are required. The sampling methods must be systematic and not rely solely on expert opinion. The fidelity of the combat training scenarios will depend largely on the adequacy of the sampling methods.

In the past the major fidelity issue has been, "How much fidelity is enough?" That is, how much must the simulator physically and functionally resemble the weapon system? Current simulation trends (CTC, embedded training, appended devices) employ the weapon system in training; hence. physical and functional fidelity issues assume less importance. As the questions about amount of fidelity diminish in importance, they are replaced by questions about kinds of fidelity; that is, "What characteristics of combat environments must be simulated in order to ensure high probabilities of transfer to war-fighting?"

A type of fidelity that has not been given adequate attention may be broadly described as combat environment fidelity. Combat environment fidelity encompasses characteristics and behavior of the threat, behavior of other friendly forces, terrain and man-made cultural features, operator workload and information processing requirements, physical environment conditions (visibility, NBC, temperature)

and support functions (logistics and maintenance), etc. The examination of combat environment fidelity for use in simulated combat scenarios is a relatively untouched area.

Phase I: A first task is to identify all potential sources of information that describe combat conditions for Army mission areas. These sources will provide the information that must be sampled for inclusion in simulations. Second, the contractor will describe the advantages and disadvantages of alternative strategies for sampling conditions for inclusion in simulations and recommend analytic methods for accomplishing the required sampling.

Phase II: The objective is to demonstrate the usefulness of the techniques developed in phase I through execution of the following steps: (1) Select a mission area; (2) Acquire information regarding the combat conditions relevant to that mission area; (3) Apply the sampling strategy to select types and levels of combat environment fidelity; (4) develop a program of instruction (POI) that has sufficient combat environment fidelity; and (5) describe the implications of this POI for simulator design.

A91-209 TITLE: Enhancing Soldier Performance Capabilities

CATEGORY: Advanced Development

OBJECTIVE: To develop methods for enhancing soldier performance in the presence of high levels of situationally imposed operator workload (OWL).

DESCRIPTION: New high technology systems operated in more sophisticated battlefield environments impose high levels of workload on the operators of those systems and adversely affect operator and system performance. While efforts are underway to reduce the workload imposed on the soldier through improved design of the soldier-system interface, other approaches must also be taken to adequately address workload issues. Even with an optimal soldier system interface, high workload will continue to threaten the attainment of required levels of performance, both because some soldiers are not able to effectively cope with imposed workload and because the operational environments impose a workload on the soldier over and above that imposed by the system.

Phase I: Conduct a comprehensive review of previous work to identify: (a) categories of soldiers most likely to have low levels of workload tolerance; (b) families of functional relationships for predicting soldier performance from knowledge of the system-and environment-posed workload, and (c) intervention techniques which can be used to raise soldier performance capability in the face of high levels of imposed workload. Develop detailed plans and procedures for cost effective methods to implement, evaluate, and field the intervention techniques.

Phase II: Execute the plans developed during Phase I. The long term goals are two-fold: (1) To develop and validate families of functional relationships for predicting the workload experienced by and the performance capabilities of identifiably different categories of soldiers. (2) To develop methods for enhancing soldier workload tolerance and performance using techniques such as special skill training for multiple task performance (that could, for example, emphasize methods to optimize task prioritization, task performance queuing, and task shedding).

A91-210 TITLE: Automated Hover Trainer Expert System

CATEGORY: Advanced Development

OBJECTIVE: To develop an expert system to provide rule guided verbal feedback to enhance training effectiveness of the existing helicopter Automated Hover Trainer (AHT). The expert system will derive rules regarding the most effective way to train neophyte Army aviators to hover and will implement those rules on an existing low cost visual flight simulator to provide effective hover training without the current requirement for a dedicated Instructor Pilot (IP).

DESCRIPTION: ARI has developed and evaluated a low cost helicopter simulator designated as the UH-1 Training Research Simulator (UH-1TRS). The UH-1TRS has been evaluated in six research efforts to date and has been found to deliver positive Transfer of Training (TOT) to the UH1 helicopter. In addition, research has demonstrated that the UH-1TRS is capable of training neophyte flight students in basic hovering maneuvers. Hardware is currently installed to generate synthesized speech to provide feedback to trainees. There is a need to develop software to use the existing hardware (the UH-1TRS and the Texas Instruments voice generator) to provide improved hover training by verbally guiding the flight student in the learning of the hovering flight maneuvers.

Phase I: Initial work will develop and evaluate expert system software to guide and enhance the automated training of basic hovering maneuvers. The goal is to become familiar with existing hardware and software that comprise the UH-1TRS and with research previously accomplished using the AHT. The contractor will develop an expert-system-based training program to both train neophyte Army flight students in the rudiments of hovering flight using computer generated voice feedback to guide their training and to evaluate their progress in training. The automated training system must support the current real- time simulation without slowing the aerodynamic calculations or the generation of images. Currently the nominal throughput delay is 84ms and the image update rate is 30Hz. The overall objective is to lower the cost of flight training by substituting low cost unmanned simulator training for helicopter training in the early portion of Primary Phase Initial Entry Rotary Wing (IERW) training.

Phase II: Once the concept has been developed and proven for rudimentary hovering maneuvers, the next development phase will extend the concept of expert system based training in a low cost simulator to other Primary Phase IERW maneuvers. Examples of target maneuvers to consider for this advanced application are: normal takeoff, traffic pattern, normal approach, hovering autorotation, simulated engine failure at altitude, and maximum performance takeoff.

US ARMY MEDICAL RESEARCH AND DEVELOPMENTAL COMMAND

A91-211 TITLE: Environmental Health Monitoring Equipment - Ambient Temperature Sensor Suite

CATEGORY: Exploratory Development/Advanced Development

OBJECTIVE: Develop, fabricate and test a suite of sensors in a small hand-held device, capable of monitoring ambient dry bulb, wet bulb and black globe environmental temperatures under military field conditions.

DESCRIPTION: Heat stress is a major element of the overall medical threat across the full continuum of conflict as described in the Air/Land Battle Future Umbrella Concept and can be a significant contributor to non-battle injuries. Effective heat stress prediction and prevention of casualties requires a comprehensive, integrated program that involves policy, doctrine and technology to predict heat casualties and unit effectiveness, and to determine water requirements and allowable work-rest cycles. The operational concept calls for the application of emerging technologies to the development of a family of monitoring devices and decision aids which make use of real-time measurements of environmental temperatures and other parameters, weather forecasts and mathematical models. The suite of monitoring devices (sensors) to be developed under this solicitation must measure ambient dry bulb, wet bulb and black globe temperatures. The sensor suite will be a component of a device capable of computer-assisted calculations based upon the information input by the operator. Therefore, the sensor suite must be accurate, portable, rugged, easy to use and capable of operation in extreme field environments by non-technical personnel.

Phase I: Identify a viable concept or device with sufficient laboratory data to demonstrate

feasibility.

Phase II: Further develop the concept and deliver a device for government testing.

A91-212 TITLE: Real-Time, Light Weight, X-Ray Imager

CATEGORY: Exploratory Development/Advanced Development

OBJECTIVE: The production of a real-time digital x-ray imager family capable of replacing the 8x10 and 14x17 inch photographic film cassettes used currently.

DESCRIPTION: The ideal imager would be roughly the size of current x-ray cassettes with a resolution of between 1024x820 and 2048x1640 pixels. It should include a frame grabber/image display unit and be battery powered. Images should be captured and displayed in less than 5 seconds. Total weight, including batteries and carrying case, 30 pounds.

Phase I: Experimental work and analysis to show that the proposed imaging technology has the potential to achieve the Phase III Goal.

Phase II: Construction and testing of a working prototype system.

A91-213 TITLE: A Temporary Dental Restorative Material for Military Field Use

CATEGORY: Exploratory Development

OBJECTIVE: To develop a temporary dental restorative material(s) that meets the stringent requirements necessary for use as an emergency dental restorative material in the military field situation. Such a material would be appropriate for the similar, but less stringent, requirements of civilian dentistry as well, and could be produced and marketed by a major dental manufacturing firm.

DESCRIPTION: Current temporary dental restorative materials exhibit poor handling, physical, mechanical and shelf life properties. A new material(s) is needed that fulfills the following requirements: stable under extremes of age and environment, easily handled in the military field situation, thermal expansion coefficient similar to tooth structure, sufficiently strong and rigid to resist occlusal forces as a temporary restoration, self-adhesive to tooth enamel and dentin, releases fluoride, thermally insulating, compatible with vital pulp tissue, inexpensive and easily obtained.

Phase I: Phase I experimental results must prove that the requirements for a temporary dental field material listed above may be met either by development of a new material or by modification of the physical, chemical, biological and mechanical properties of existing dental restorative materials.

Phase II: Phase II will be advanced product development to include in vivo and in vitro laboratory and field testing in conjunction with U.S. Army Institute of Dental Research (USAIDR), that proves that the material(s) is appropriate and efficacious for military field use.

A91-214 TITLE: Development of Biodegradable Polymeric Delivery Systems for Bone-Inductive Proteins and Growth Factors

CATEGORY: Basic Research/Exploratory Development

OBJECTIVE: To develop biodegradable, biocompatible polymeric delivery systems for use in maxillofacial reconstructive surgery to prevent soft-tissue collapse and provide controlled release of bone-

inductive proteins and growth factors into bony wound sites.

DESCRIPTION: Beginning in early 1991, substantial amounts of genetically engineered bone-inductive proteins may be marketed. There is an immediate need to develop biodegradable polymeric delivery systems for these active proteins. Such delivery systems are required for two reasons. First, the polymer will contain the protein, delivering it directly to the wound site at a specified time, or over a specified period of time, thus preventing washout and loss of protein activity. Second, the polymer will protect the bone-inductive protein from in situ degradation by nonspecific proteinases until it is released. Suitable polymers would be biocompatible and could be used in various forms, such as porous blocks (pore size 300 microns or larger), microcapsules, or waxes to be used as hemostatic agents.

Phase I: Submission of biocompatible, biodegradable polymers into which bone-inductive proteins can successfully be incorporated without loss of bioactivity as assessed in animal models.

Phase II: Submission for clinical trials of deployable bone-repair materials containing active bone-inductive proteins in biocompatible, biodegradable polymeric delivery systems.

A91-215 TITLE: Development of Diagnostic Probes for the Detection and Surveillance of Drug Resistant Parasitic Infections

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to develop probe(s) that will provide rapid field identification of drug resistant Plasmodium falciparum malaria and Leishmania species.

DESCRIPTION: The phenomenon of resistance to drugs by prokaryotic and eukaryotic pathogens is a matter of great practical concern. The prevalence of multidrug resistant strains of P. falciparum and the unresponsiveness of cutaneous and visceral leishmaniasis to antimonial therapy is a serious clinical problem that represents an important threat to the management of these diseases. There is a growing demand for the development of a rapid diagnostic test that will allow a complete direct identification of drug-resistant parasites in easily obtainable patient samples. The probes would call for a single reading of results by semi-skilled technical staff. The probes should be specific, sensitive, and inexpensive. The quantities required for in vitro and field testing of each probe submitted is about 100 and 1000 reactions respectively.

Phase I: Submission of potential probe(s) in the appropriate quantity and quality for in vitro testing against reference drug resistant and sensitive parent clones of the parasites.

Phase II: Submission of additional quantities of specific probe(s) for field testing and evaluation.

A91-216 TITLE: The Molecular Biology of the Mechanisms of Antiparasite Drug Action and Resistance

CATEGORY: Basic Research

OBJECTIVE: To gain an understanding of the molecular basis of drug resistance in parasites. These data will be used to evaluate and develop novel chemical agents for combating drug resistant parasites.

DESCRIPTION: The utility of current chemotherapeutic drugs for the treatment of malaria, leishmaniasis and schistosomiasis is becoming less effective due to drug resistant parasites. In order to develop or adapt drugs whose efficacy is not compromised by this resistance, the molecular biology of drug resistance needs to be fully elucidated. Data have suggested that multi-drug resistant protein, p-glycoprotein 170 (pgp 170), may facilitate drug efflux. Additional data is needed on the structure of transport protein(s), the mechanism of drug efflux, and the identification and characterization of the

gene(s) involved.

Phase I: The identification and characterization of multi-drug transport protein(s) and gene(s).

Phase II: The development of drugs that will modulate the multi-drug resistance phenotype and the use of Phase I data to empirically ascertain the phenotype of drug-resistant parasites.

A91-217 TITLE: Development of a Small Animal Infection/Protection Model for Dengue-3 Virus

CATEGORY: Exploratory Development

OBJECTIVE: Development of a small animal infection model for dengue-3 virus to assess the protective capacity of dengue-3 sub-unit and whole virus candidate vaccines.

DESCRIPTION: A reliable protection model to assess the protective capacity of dengue-3 virus antigens is currently unavailable. Dengue-3 viruses, members of the family Flaviviridae, are major public health threats in the tropics, causing epidemic and endemic disease. Candidate vaccines being developed include live attenuated virus strains, sub-unit preparations using protein antigens prepared by recombinant methods, or synthetically prepared polypeptides. The development of protective candidate vaccines would be enhanced by early evaluation in immunologically competent small animals. Small animal infection models already exist for other dengue viruses (dengue-1, 2, and 4) in weanling and young adult mice. No dengue-3 virus strains have been developed which can infect mice older than about 12 days.

Phase I: Develop dengue-3 virus strains which can reliably infect young adult mice or a similar small animal model. Mouse neurotropic dengue-3 virus (for suckling mice) will be provided by the Government. Other strains will be provided if necessary. This work will be performed in close coordination with inhouse investigators at the Walter Reed Army Institute of Research.

Phase II: Develop a protection assay to assess the immunological potential of selected dengue-3 antigens (provided by the Government) using the infection model developed in Phase I. The contractor will assess the protective capacity of the selected antigens and report on their immunological potential.

A91-218 TITLE: Production of Polyclonal Antibodies in Rabbits

CATEGORY: Exploratory Development

OBJECTIVE: To produce polyclonal antibodies in rabbits to proteins, enzymes, synthetic peptides, and monoclonal antibodies.

DESCRIPTION: A requirement has been established for antibodies from animals other than mice raised against acetylcholinesterase, butyrylcholinesterase, glycosylated butyrylcholinesterase, synthetic peptides which mimic selected areas of the HIV virus proteins, and monoclonal antibodies which inhibit catalytic activity of acetylcholinesterase. Antibodies will be used as capture antigens for assays and to monitor binding and/or blocking of mouse monoclonal antibodies, and in the case of those raised against mouse monoclonal antibodies (anti-idiotypic antibodies), as probes for the elucidation of the topography of the original antigen. Antibodies will be elicited by injection of compounds of interest (synthetic peptides, enzymes, peptides), which will be provided by Walter Reed Army Institute of Research (WRAIR). Antibody production will be monitored by binding assays (ELISA) using the injected compounds as antigens. Pre-injection binding assays (negative controls) and periodic binding assays during the course of the injection schedule will be performed to monitor the buildup of antibody. Results of binding assays will be submitted to WRAIR for approval.

Phase I: Production in 2-3 rabbits of polyclonal sera of adequate titer against each antigen.

Phase II: Upon successful production of polyclonal sera, expansion of the repertory of antigens and large-scale production of serum.

A91-219 TITLE: Development of a Cold Sterilant for Field Medical Use

CATEGORY: Exploratory Development

OBJECTIVE: Develop a powdered sterilant that can be added to water to effect the cold sterilization of surgical instruments, including delicate units such as endoscopes.

DESCRIPTION: The preferred method for cold sterilization, ethylene oxide gas, has been eliminated from field medical use because of hazards in transporting and using the material. Activated glutaraldehyde is being used as a replacement sterilant; but it has many undesirable characteristics involving logistics support, user safety, and product effectiveness. An alternative cold sterilant needs to be developed which is effective against pathogens and is safe for delicate instruments. Furthermore, it should be packaged as an inert powder for safe, efficient transportation and storage; and the waste solution should not pose a toxic hazard to users.

Phase I: The Phase I effort will involve the formulation of one or more powdered sterilants and the demonstration that these products are effective against viral, bacterial, and fungal contaminants.

Phase II: Phase II will involve more extensive product testing to acquire data on its performance, stability, and toxicity. A product suitable for field testing should emerge from this effort.

A91-220 TITLE: Development of Field Portable Methods for Amplification of Gene Probes for Use in Water Quality Analyses

CATEGORY: Basic Research

OBJECTIVE: Develop field portable technology which will allow the rapid detection of waterborne microbial pathogens or their indicators. New procedures will build upon gene probe technology for which amplification of probes is required to measure microbial constituency.

DESCRIPTION: The rapid detection of indicator organisms or specific pathogens in military field drinking water supplies is required to protect the health of soldiers in combat and training. Currently, the detection of microorganisms in field water requires 24 hours in which time water must often be consumed (before its quality is known). The ability to detect waterborne organisms in 1 hour under field conditions is required.

Phase I: Demonstrate the general efficacy of a gene probe amplification technology for use on water samples with low levels of specific microorganisms (indicator and pathogenic microorganisms). Technology must show that it has reasonable characteristics which would make it amenable to the development of field capabilities.

Phase II: Develop the technology so that it can be used in a field mode constrained by power, space, weight, logistical support, technical complexity, and expertise/training limitations. Technology must be able to work with field water samples which may be of poor physical/chemical quality, therefore, requiring separation of microbiological organisms from interfering conditions. The technology must provide a six-order-of-magnitude amplification of gene probes in approximately 1 hour.

A91-221 TITLE: Preclinical Testing of Viral Vaccines

CATEGORY: Basic Research

OBJECTIVE: To develop new methods, using modern technology, to evaluate vaccine safety and potency for comparison with procedures mandated by historical use with licensed vaccines.

DESCRIPTION: Improve upon existing procedures and develop new technologies for the pre-clinical evaluation of recombinant vaccinia virus vaccines. Develop new methods, using modern technology, to evaluate vaccine safety and potency for comparison with procedures mandated by historical use with licensed vaccines. Explore additional virus characteristics potentially important for human testing and environmental release.

Phase I: Evaluate the application of modern biotechnology to improving the current laboratory testing procedures used for evaluating the safety and efficacy of infectious human virus vaccines. Develop new procedures for the detailed examination of virus characteristics of potential importance in the field use of recombinant vaccines.

Phase II: Comparatively test recombinant virus vaccines using both classical procedures and various new or improved testing procedures. Proposal and results should demonstrate the relative efficiency and efficacy of the new testing procedures for existing vaccine candidates at the preclinical IND level. A priority target of these studies is that data generated must be GLP based and suitable for IND application submissions.

A91-222 TITLE: Integration of Instrumentation for Measuring Vital Signs

CATEGORY: Advanced Development

OBJECTIVE: Identify commercially available products that automatically, reliably, and noninvasively measure vital signs (blood pressure, heart rate, blood oxygen content, and temperature). Integrate these products into a small, light weight, and rugged unit that will operate in the field medical environment.

DESCRIPTION: The monitoring of blood pressure, heart rate, blood oxygen content, and temperature is integral to good patient care, particularly in an emergency situation. Small, reliable instruments are available commercially for measuring these parameters automatically, continuously, reliably, and noninvasively. Compared to manual procedures, these products provide better measurements in reduced time. Efforts to develop a vital signs monitor for field medical use have involved the de nova construction of basic components, which largely have performed less well than their commercial counterparts. A small, lightweight, and rugged vital signs monitor can be fabricated by integrating proven technology from one or more vendors.

Phase I: The Phase I effort would involve identifying instruments that the measure the desired vital signs and that have the following characteristics: small, lightweight, self-contained, rugged, and capable of operating in a chemical and a high noise/high vibration environment. The instrument(s) should measure blood pressure and heart rate through thick clothing such as a field jacket or chemical protective ensemble. The instrument(s) should measure temperature and blood oxygen content non-invasively.

Phase II: Phase II will involve the development of a prototype monitor which integrates the electronics of the instruments identified in Phase I along with necessary probes, cuffs, and sensors. The prototype monitor should be modular in so far as components, which can operate alone, also can be inserted into a common electrical source and data transfer can pass to a single RS-232C outlet.

A91-223 TITLE: Vesicating or Blister Agents

CATEGORY: Basic Research

OBJECTIVE: Identify model systems for the identification of countermeasure approaches; Determine the pharmacological characteristics of pretreatment/antidotes that will prevent cell death caused by vesicant agents.

DESCRIPTION: After conducting a thorough literature search, use novel techniques, in vitro and in vivo, to investigate the mechanisms of action of blister agent damage. Investigate pre/treatment regimens.

Phase I: Preliminary data that will show the concept feasibility and the merit of further investigation.

Phase II: Experimentation that will demonstrate the practicality of the research as it relates to military medical defense.

A91-224 TITLE: Pulmonary Agents

CATEGORY: Basic Research

OBJECTIVE: Identify appropriate model systems for the study of agent effects and investigate countermeasure approaches; Identify fast and easy casualty stabilization methods; Determine a pretreatment/treatment regimen that protects against incapacitating effects without causing Central Nervous System (CNS) side effects.

DESCRIPTION: After conducting a thorough literature search, use novel techniques to investigate the mechanisms of action of respiratory agent damage. Investigate pre/treatment regimens.

Phase I: Preliminary data that will show the concept feasibility and the merit of further investigation.

Phase II: Experimentation that will demonstrate the practicality of the research as it relates to military medical defense.

A91-225 TITLE: Blood Agents

CATEGORY: Basic Research

OBJECTIVE: Identify appropriate model systems for the study of agent effects; Investigate pretreatment countermeasure approaches.

DESCRIPTION: After conducting a thorough literature search, use novel techniques to investigate the mechanisms of action of blood agent damage. Investigate pretreatment regimens.

Phase I: Preliminary data that will show the concept feasibility and the merit of further investigation.

Phase II: Experimentation that will demonstrate the practicality of the research as it relates to military medical defense.

A91-226 TITLE: Neurotoxins

CATEGORY: Basic Research

OBJECTIVE: Identify appropriate model systems for the study of agent effects and investigate

countermeasure approaches; Identify antibodies (antitoxins) directed against common features of neurotoxin molecules that do not have central nervous system side effects; Identify reagents that rapidly identify neurotoxins either specifically or as members of neurotoxin class.

DESCRIPTION: After conducting a thorough literature search, use novel techniques to investigate the mechanisms of action of neurotoxin damage. Investigate pre/treatment regimens.

Phase I: Preliminary data that will show the concept feasibility and the merit of further investigation.

Phase II: Experimentation that will demonstrate the practicality of the research as it relates to military medical defense.

A91-227 TITLE: Medical Countermeasures Against "Toxic Agents of Biological Origin"

CATEGORY: Basic Research

OBJECTIVE: Provide new methods of therapy and prophylaxis for biological toxin.

DESCRIPTION: Biological toxins, such as saxitoxin, blue-green algal toxins, botulinum and anthrax toxins, ricin and snake/animal protein toxins have been suggested as potential threat agents. The molecular sites of action of many of these toxins have been identified, however appropriate therapy and prophylaxis is not available. Research proposals designed to investigate potential medical countermeasures such as vaccines, antibodies or drug prophylaxis and treatment regimes are strongly encouraged.

Phase I: Demonstrate usability of new methodology for a single toxin.

Phase II: Demonstrate usability of methodology for a variety of biological toxin from various diverse sources, plant, bacteria, etc.

A91-228 TITLE: Monoclonal Antibodies Against Biological Toxins

CATEGORY: Basic Research

OBJECTIVE: Provide monoclonal antibodies for specific toxins and treat agents.

DESCRIPTION: Using novel techniques of in vitro stimulation of human spleen or peripheral cells or recombinant conversions of mouse monoclonals, produce human monoclonal antibodies with specificity for important toxins and threat agents. Antibodies with specific toxins such as: blue-green algal toxins (microcystin, anatoxin A), dinoflagellate toxins (saxitoxin, gonyautoxins, brevetoxin, palytoxin), vertebrate toxins (tetrodotoxin, batrachotoxin), protein synthesis inhibiting plant toxins (ricin), protein and peptide toxins of other biological origin (including pre- and postsynaptic neurotoxins, and membrade active substances) and dermally active toxins (Lyngbyatoxin). Physiologically active compounds of biological origin are also of interest. And threat agents such as: anthrax, tularemia, Q-fever and human pathogens of alphaviridae, flaviviridae, bunyaviridae, filoviridae and areaviridae.

Phase I: Show efficacy ofnovel techniques.

Phase II: Produce research quantities of specific human monoclonal antibodies.

A91-229 TITLE: Cellular Immune Response to Diseases of Military Importance

CATEGORY: Basic Research

OBJECTIVE: To develop new, senstive, quantitative tests to monitor cellular immunity as a response to vaccinations.

DESCRIPTION: Recovery from, and perhaps protection against, several diseases of military importance is mediated by cellular immunity. Sensitive, quantitative, and easily applied tests to detect relevant responses are needed both in evaluation of the immune status of antibody-negative subjects and to monitor vaccine development. Typical systems in which such responses are thought to be biologically relevant include diseases caused by arenaviruses, filoviruses, and hantaviruses.

Phase I: Demonstrate proof-of-principle using a virus from those viruses listed.

Phase II: Demonstrate usability in specimens from infected individuals.

A91-230 TITLE: Medicinal Chemistry - Synthesis of Potential Drugs Effective Against Toxic Agents of Biological Origin

CATEGORY: Basic Research

OBJECTIVE: Develop prophylactic/therapeutic compounds for treatment of intoxications caused by biologics.

DESCRIPTION: Toxic agents of biological origin such as botulinum toxin, anthrax toxin, palytoxin, saxitoxin, brevatoxin, ricin, etc. are potential threat agents. There is an interest in chemical compounds which potentially will prevent (pretreatment) and/or counteract (antidote-treatment) the toxic effects of such, or any individual agent(s). Airways or systemic applications will be considered. The drugs need to be reasonably non-toxic and fast acting. The compounds proposed should be based on a biological-rationale and the compounds prepared are to be submitted in 3-5 gram quantities, for biological evaluations. The submitted compounds are to be fully characterized, be of high purity (>99.5%), for screening against the targeted threat area.

Phase I: Demonstrate efficacy of compound in a model system.

Phase II: Demonstrate efficacy against other toxins.

A91-231 TITLE: Detection and Diagnosis for Toxin Exposure

CATEGORY: Basic Research

OBJECTIVE: Develop a system to detect/diagnos the presents of toxins.

DESCRIPTION: Develop systems to detect/diagnose toxins in biological or environmental samples. Development of means of detection or diagnosis of exposure to toxins of interest; systems must be sensitive, specific, reliable, and rapid for field use. Systems should be applicable to biologic matrices such as blood, urine or other clinically obtainable samples, although a simple qualitative test kit for identification of multiple toxins in environmental samples would also be of interest. Toxins of principal interest include ricin, microcystin, botulinum toxin, palytoxin, saxitoxin and staphylococcal enterotoxin B as well as other low molecular weight, peptide, and protein toxins. Diagnostics for channel active toxins, pre- and post synaptic toxins, and protein syntheses inhibitors are of interest.

Phase I: Show proof-of-principle.

Phase II: Show utilization of the system for a variety of toxins in a variety of menstruums.

STRATEGIC DEFENSE COMMAND

A91-232 TITLE: Optical/Ladar Tracking Systems for Kwajalein Atoll (KA) Application

CATEGORY: Advanced Development

OBJECTIVE: The objective of this effort is to investigate innovative, low cost optical and/or ladar system(s) to provide precise instrumentation data on incoming reentry objects and outgoing sounding rockets/experimental missiles.

DESCRIPTION: Current methods at the KA for providing instrumentation data involves large frame size cameras (70 mm) with several focal-length lens. The high speed film (90 to 360 frames per second) requires time to process and is very expensive to maintain. Alternative recording systems are desired to collect high resolution data for reference, verification, and calibration of data collected by other experimental sensors. Innovative, low cost alternative optical and/or ladar concepts are of interest.

Phase I: The phase I is to define a low cost concept to meet the objective above and to show that the concept is feasible.

Phase II: The Phase II objective is to further develop the concept to fully demonstrate that the concept can meet the requirements if installed.

A91-233 TITLE: Impact Detection System for Kwajalein Atoll (KA) Application

CATEGORY: Advanced Development

OBJECTIVE: The objective of this topic is to investigate an innovative, low cost system to detect and locate the impact and resulting splash of reentry vehicles at KA.

DESCRIPTION: There is a current need to explore alternative or improvements to the present hydroacoustic impact timing system used to detect and locate the splash of reentry vehicles arriving at the lagoon at KA. The data generated by the system is used to score the performance of the reentry vehicles. The proposed system should provide, as a secondary feature, safety surveillance of water craft in the target area. The proposed system should have all weather capability.

Phase I: The phase I is to define a low cost concept to meet the objective above and to show that the concept is feasible.

Phase II: The Phase II objective is to further develop the concept to fully demonstrate that the concept can meet the KA requirements if installed.

A91-234 TITLE: Search and Recovery of Reentry Vehicles at Kwajalein Atoll (KA)

CATEGORY: Advanced Development

OBJECTIVE: The objective of this topic is to investigate innovative, low cost systems for detecting and retrieving reentry vehicles and debris from the lagoon at KA.

DESCRIPTION: There is a need to explore alternative or improvements to the present systems to detect, locate, and retrieve vehicles and debris after their arrival at KA. These objects are submerged on the bottom of the lagoon area. Current methods employ divers using scuba equipment, a two-man submarine, and a remotely operated vehicle. The proposed methods should include safe handling procedures.

Phase I: The phase I is to define a low cost concept to meet the objective above and to show that the concept is feasible.

Phase II: The Phase II objective is to further develop the concept to fully demonstrate that the concept can meet the KA requirements if installed.

A91-235 TITLE: Tracking Radar Advanced Signal Processing and Computing for Kwajalein Atoll (KA) Application

CATEGORY: Advanced Development

OBJECTIVE: The objective of this topic is to investigate enhanced signal processing hardware and algorithms to improve the capabilities of tracking radars.

DESCRIPTION: There is a need to explore alternative methods to provide low cost, improved capabilities for the tracking radars. Unique and novel ideas are needed to enhance the detection, tracking, target resolution, and discrimination functions performed by these radars. The methods proposed should be capable of being incorporated into current radars and offer improvements in the processing capabilities. The current tracking radars include the AN/MPS-36, AN/FPQ-19, ALCOR, TRADEX, and Millimeter Wave radars.

Phase I: The phase I is to define a low cost concept to meet the objective above and to show that the concept is feasible.

Phase II: The Phase II objective is to further develop the concept to fully demonstrate that the concept can meet the KA requirements if installed.

A91-236 TITLE: Range Safety Radar Processing and Computing for Kwajalein Atoll (KA) Application

CATEGORY: Advanced Development

OBJECTIVE: The objective of this topic is to investigate enhanced signal processing algorithms to be used in range safety operation.

DESCRIPTION: There is a current need to explore alternative methods to provide information on the location and tracking of airborne vehicles for range safety. The exclusive purpose of these algorithms is to provide real time flight safety control for airborne vehicles leaving or entering the control area. These algorithms must provide tracking at low and high elevations, and in real time to support range safety. The proposed methods should provide improvements in the signal processing with minor impact to current hardware. The Range Safety System consist of dedicated transmitters, antennas, graphics displays, computers, software, and sensor safety object data required to perform the Range Safety function.

Phase I: The phase I is to define a low cost concept to meet the objective above and to show that the concept is feasible.

Phase II: The Phase II objective is to further develop the concept to fully demonstrate that the concept can meet the KA requirements if installed.

A91-237 TITLE: Debris Scattering Prediction for Kwajalein Atoll (KA) Application

CATEGORY: Advanced Development

OBJECTIVE: The objective of this topic is to investigate innovative methods for determining the

generation of debris scattering that results from the impact of two ballistic objects. This method is to provide safety information needed to prevent damage to air and surface crafts in the area.

DESCRIPTION: There is a need to determine methods of predicting the generation and scattering of debris from the impact of two ballistic objects. The impact produces debris that falls to the earth creating a hazard for aviation and surface ships. It is desired to have a debris model developed which predicts the particle size, direction, velocity, etc. This should be developed as a computer model to be used by safety personnel in the field.

Phase I: The phase I is to define a low cost concept to meet the objective above and to show that the concept is feasible.

Phase II: The Phase II objective is to further develop the concept to fully demonstrate that the concept can meet the KA requirements if installed.

A91-238 TITLE: Biologically Motivated Nonlinear Dynamics for Smart Weapons

CATEGORY: Basic Research

OBJECTIVE: Develop and implement software and/or hardware based nonlinear dynamical systems that exhibit biological-like qualities, such as autonomy, fast learning and adaptation, that can be applied to detection, discrimination, tracking, interception, and kill assessment.

DESCRIPTION: Development of nonlinear dynamical systems, with phase space characteristics similar to biological organisms, will allow the development of reliable and adaptable sensing and processing solutions for smart weapons systems. Vast amounts of data must be processed in the detection, tracking and discrimination in order to determine and kill lethal targets. Biological systems have evolved to solve many of the problems faced by smart weapon systems. Understanding the dynamics of biological systems will make steps toward developing lighter weight, less expensive and more reliable intelligent weapon system components. Elements of this research include but are not limited to, insect optical-neural processing for a very wide field of view angle of arrival photon detectors, massively parallel analog computing, genetic algorithm designing of neural structure, fuzzy logic systems, cellular automata systems and coupled oscillator neural network models that make use of neuron firing phase.

Phase I: The objective is to develop a theoretical and/or experimental nonlinear dynamical model and prove its utility for solving a practical intelligent weapon system problem or a subset thereof. Also, to assess its feasibility, potential range of applicability and performance.

Phase II: The objective is to implement in software and/or hardware the model developed in phase I, and experimentally verify and modify the theory to estimate actual utility and range of performance for the concept. This proof of principle phase should emphasize any potential improvements in performance over conventional approaches.

A91-239 TITLE: Pulsed Carbon Dioxide Laser Propagation Analysis Capability

CATEGORY: Advanced Development

OBJECTIVE: The objective is to study and quantify the interrelationship between the atmosphere and high energy pulsed carbon dioxide lasers. The technology required for accurate beam profile and wavefront measurements has recently been developed but has not been applied to field measurements of this type. The subject technology is the enlargement of two dimensional far infrared starring arrays to the 512 x 512 detector array regime.

DESCRIPTION: This capability will allow high resolution "snapshot" beam profiles of the far field

beam to be captured and analyzed for quantifying the effect that high energy pulses have on atmospheric propagation (and the effect the atmosphere has on pulse characteristics). The results can be applied to a variety of technical areas and instrumentation to perform the validation of beam propagation models, integration with adaptive optics, and the conduct of damage assessment quantification.

Phase I: The objective is to study the application of these large scale starring arrays on the measurement of short duration beam profiles and wavefront measurements.

Phase II: The Phase II objective is to further development, test, and validation of the subject measurement system concepts to meet the measurement requirements.

A91-240 TITLE: Glint Return Tracking Capability for Far IR Pulsed Lasers

CATEGORY: Advanced Development

OBJECTIVE: Using data available from large scale starring arrays, implement an active tracking capability for high energy pulse laser systems. Current active tracking systems (utilizing glint return from the target) are utilized only for continuous wave lasers. Due to the recent development of large scale far IR two dimensional arrays, the technology now exists to expand the active tracking previously reserved for CW laser systems to pulsed laser systems.

DESCRIPTION: The technology developed from this effort can be applied to tracked pulsed laser weapon systems to improved range and accuracy on aimpoint designation systems. Initial integration of the system would be with the Pulsed Laser Vulnerability Test System (PLVTS). The PLVTS is a threat surrogate laser for the conduct of damage and vulnerability testing of U.S. tactical weapons systems and materials.

Phase I: The objective is to investigate integrating large scale far IR detector arrays with current active tracking systems for use with high energy pulsed laser systems.

Phase II: The objective is to develop an active tracking system to test and validate the results of the phase I effort.

A91-241 TITLE: High Energy Laser Target Plane Beam Diagnostic Instrumentation (BDI) Development

CATEGORY: Advanced Development

OBJECTIVE: The objective of this development effort is to create an effective target plane Beam Diagnostic device(s) which will be acceptable to the High Energy Laser (HEL) test community.

DESCRIPTION: The HEL testing at the High Energy Laser Systems Test Facility (HELSTF) would be significantly enhanced if a method for determining the exact beam characteristics at the target plane were developed. In the past, there have been uncertainties about the quantity of the beam reaching the target, which caused diagnostic and analytical problems for testers. A more reliable beam diagnostic method(s) at the target plane would provide testers with the most accurate information about the quality of the beam actually put on target, and would remove the uncertainties introduced to the analytical process. The new device(s) which might be developed would operate in all HELSTF test areas, namely, Test Cell-B (TC-B), Effects Test Area (ETA), and the Large Vacuum Chamber (LVC).

Currently, several beam diagnostic measurements are made in both the Low and High Power Optical Trains up-beam from the target plane. Specific beam quality information which is required includes a HEL beam intensity profile and power measurements. The HEL beam power has previously been measured using both ball calorimeters and scatter plates. These measurements need to compensate for both turbulence contributions and beam smoothing techniques.

Phase I: The objective is to conduct a thorough study of the previous beam diagnostic efforts, understand and document the problems which have preceded this effort and recommend an improved approach to Beam Diagnostics.

Phase II: The objective is to design and fabricate the breadboard beam diagnostic device and techniques required to obtain target plane beam information.

A91-242 TITLE: Photonics and Optical Computing Research

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to develop innovative optical materials, devices, components, architectures, and algorithms that will advance the technology. The innovative concept shall lead to a product that will increase performance for a specific function and/or reduce the power, weight, size, etc., of a component required by an Army system. This can be in any aspect of BM/C3, surveillance, acquisition, tracking, or kill assessment.

DESCRIPTION: Orders of magnitude advancement in performance is needed in hybrid optoelectronic and in all computing and signal processing systems. This requires new and significantly enhanced nonlinear materials and photonic devices, acousto, and electro-optic components, optically and electronically addressed spatial light modulators, array processors, holographic techniques, high-density memory, reconfigurable interconnects, methods of massive fan-in/fan-out, and parallel algorithms and architectures. Applications include optical neural-network processors as well as general-purpose optical analog and digital computers and special purpose optical coprocessors and accelerators.

Phase I: The results of this effort will provide proof-of-concept feasibility by means of preliminary design, simulation, and laboratory experimentation. The product should be directly linked to some subsystem of an Army program and also have potential commercial application.

Phase II: The results of this effort will include the detailed design, fabrication, demonstration, and testing and evaluation of a working, but not necessarily optimized, breadboard model.

A91-243 TITLE: Microelectronics and Materials Research

CATEGORY: Basic research

OBJECTIVE: The objective of this topic is to provide the necessary advances in electronic materials in order to improve the technology base for designing and developing lightweight, radiation hard, high performance electronic circuits for use in interceptors, active and passive sensors, and data/signal processing devices used in Army applications.

DESCRIPTION: Technologies with early maturation for Army applications are of primary interest. Novel ideas which lead to improved miniaturization, power consumption, passive cooling, packing density, reliability, cost, producibility, data/signal processing performance or capabilities of electronic and/or optoelectronic circuits are sought.

Phase I: This phase should demonstrate the feasibility and scientific or technical merit of the proposed idea in order to reduce the risk to be incurred with the Phase II effort. The demonstration should consist of an experiment or simulation that clearly shows the potential of the concept, ie. the fabrication and characterization of a high speed transistor using new materials and novel processing or design concepts.

Phase II: This phase should address critical issues and result in a well defined product or process ready for the commercial development of a specific application. For example: activities would consist of determining performance as a function of process variables and addressing the critical issues, which could include the integration of, perhaps, a transistor with the other elements of a logic circuit for

a given Army application.

A91-244 TITLE: Advanced Signal/Data Processing Research

CATEGORY: Exploratory Development

OBJECTIVE: New and innovative approaches offering order-of-magnitude improvements to sensor signal/data processing performance, power, weight, size, and cost are desired.

DESCRIPTION: Modern sensors produce a vast amount of electronic signal information which must be processed quickly and accurately to perform surveillance and target tracking functions. Signal processing of the sensor data is first performed to identify object detections. Typically these are time dependent processors that involve background removal, spike adaptation, filters, peak detection, edge enhancement, signal to noise improvement, signal conditioning, noise rejection, etc.

Next, data signal processing is performed to identify object direction, orientation, and discrimination. Typically these object dependent processors involve separating closely space objects, range and velocity estimations, Kalman filtering, aim point selection, etc.

Phase I: A Phase I effort will identify one or more specific functional elements of the signal/data processing chain and seek a sizeable and realizable improvement to the components. This will include design and simulation of the improvement and proof of its technical merits.

Phase II: Phase II will develop the signal/data processing improvements from Phase I for a more detailed simulation/prototype demonstration of the advantages of the resulting hardware or algorithm.

A91-245 TITLE: Voice/Data Multiplexer for Communications

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to research technologies which will enhance the feasibility of transmitting digitized voice and data over a narrowband commercial circuit.

DESCRIPTION: There is a requirement to send encrypted voice and data over long and short distances. A significant cost savings could be realized if techniques were developed to reliably transmit both voice and data over commercial circuits. Techniques developed should attempt to maximize the use of existing commercial or military telecommunications facilities in the most cost efficient manner. Technology areas developed include, but are not limited to, source encoding, error detection and correction coding, and modulation/demodulation schemes.

Phase I: New and innovative concepts are sought which will enhance the feasibility of voice/data multiplexing. The phase I effort should be structured to determine the feasibility of the proposed concept by the end of the phase I performance period.

Phase II: After the feasibility of the proposed concepts has been established in phase I, the evolution of the concept will be continued during the phase II effort. The concepts will be implemented in hardware to demonstrate the engineering feasibility of the concept and any critical engineering bottlenecks will be addressed and solved.

A91-246 TITLE: Light Weight/High Power Radio Frequency Amplifiers for Communications

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to research technologies which will decrease the weight and increase the

output power of the current state of the art in radio frequency power amplifiers.

DESCRIPTION: There is a requirement to downlink narrow band data from a missile in flight to a ground entry point. Amplifiers developed should be capable of operating through the dynamic forces imposed during missile flight and should have long life times in a dormant state. A geostationary satellite may be used as a relay to provide line of sight connectivity. Candidate satellites for this relay operate at UHF, S-band and X-band frequencies. Light weight, high power amplifiers are required to close this link.

Phase I: New and innovative concepts are sought which will enhance the capabilities of power amplifiers. The phase I effort should be structured to determine the feasibility of the proposed concept by the end of the phase I performance period.

Phase II: After the feasibility of the proposed concepts has been established in phase I, the evolution of the concept will be continued during the phase II effort. The concepts will be implemented in software/hardware to demonstrate the engineering feasibility of the concept and any critical engineering bottlenecks will be addressed and solved.

A91-247 TITLE: Computer Architectures and Algorithms

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to demonstrate novel or innovative approaches for ground and space computer architecture, algorithms, and language to support acquisition, tracking, classification/discrimination, kill assessment, and battle management/command, control, and communication (BM/C3).

DESCRIPTION: There is a requirement to develop novel ideas that improve the state of the art and are implementable in a short period of time, as well as technical ideas for future product improvements in the following areas: computer architectures to improve processing speed, be parallel or distributed in layout, be more secure, with increased fault-tolerant capabilities, and have higher reliability are being sought; innovative algorithms to increase data processing performance, include fault tolerance, and implement novel numerical techniques are requested; languages to optimize operating systems for computer architectures, demonstrate improved man-machine interfaces, and allow for easy software updates and system testing are also of interest.

Phase I: The objective is to investigate and analyze the various approaches toward solving a particular problem area and recommend a single defined method. The method should be based on innovative concepts that will provide benefits.

Phase II: The objective is to determine the phase I method through a design, fabrication and/or encoding, and testing. During demonstration, the procedures to implement the method, schedules, resource requirements, and testing are documented and evaluated. Periodic testing provides a means of assuring that method can be successfully implemented.

PROJECT MANAGER FOR TRAINING DEVICES

A91-248 TITLE: Advances in Training Performance Assessment for Force-on-Force Training Exercises

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative approach(es) for collecting, organizing and analyzing real time

training performance data from force-on-force engagement training exercises and/or from networked trainers and simulators conducting force-on-force engagement training.

DESCRIPTION: The National Training Center (NTC) at Ft. Irwin, California, supports force-on-force combined arms maneuver training for two blue maneuver battalions operating against an opposing motorized rifle regiment. NTC's future training role is not expected to change but with the successful fielding of networked trainers and simulators, a cost effective means of conducting home-base combined arms maneuver training is anticipated. For either case, there exists the need to collect real time training data on both the blue and opposing forces as engagements evolve. This data, along with reports from operation controllers, form the basis for generating unit and commander performance assessments. Given the anticipated increase in complexity and exercise scope there is a need to optimize/automate the data collection and analysis process.

Phase I: Develop a taxonomy for performance measures and feedback for players, including those linked through networks into simulated environments and/or approach(es) for collecting, organizing, and analyzing real time training performance data. Results obtained from this process would provide input information to human instructor/analyst and/or a computerized surrogate instructor/analyst. Emphasis should be on techniques employing advance distributed/parallel processing, data base, and artificial intelligence methodologies.

Phase II: Design, model and implement the approach developed in Phase I in sufficient detail to demonstrate feasibility of concept.

A91-249 TITLE: Advances in Casualty Assessment for Force-on-Force Training Engagement

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative approach(es) for real-time casualty assessment (RTCA) of weapon engagement simulations for force-on-force training.

DESCRIPTION: With the introduction of an increasing number of smart and "fire and forget" munitions, multi-spectral sensors systems, and directed energy weapons (DEW) operating in obscured battlefields conditions, present approaches for pairing systems for real-time casualty assessment may not be adequate to support future force-on-force training.

Phase I: Develop an approach for determining RTCA of weapons engagement simulations while providing high level resolution of aspect angle and location of hit on target. Of particular interest are approaches which utilize the new and emerging capabilities of next generation fire control systems for reconnaissance, surveillance, and target acquisition.

Phase II: Design, model and implement the approach developed in Phase I in sufficient detail to demonstrate feasibility of concept.

A91-250 TITLE: Adverse Physical Factors Related to Simulators

CATEGORY: Basic Research

OBJECTIVE: To determine the causal factors (if any) of simulator induced sickness associated with fixed platforms.

DESCRIPTION: Simulator induced sickness (e.g., dizziness, nausea, disorientation) appears to be coming an increasing problem with simulators, both fixed and motion platforms, and the Army is looking toward simulators as cost effective future training devices vs the tactical weapon. Simulator induced

sickness may be a factor in reduced training effectiveness as well as negative training.

Phase I: Develop a study which would isolate the causes of simulator induced sickness associated with stationary platforms. A wide range of subjects should be considered varying from the new recruit to the veteran soldier. Visual, auditory, and tactical fidelity should be considered.

Phase II: Conduct a pilot study based on the results of the study in Phase 1.

A91-251 TITLE: Manpower and Personnel Integration (MANPRINT) Assessment Issues

CATEGORY: Exploratory Development

OBJECTIVE: Identify key MANPRINT domain variables and their relationships which should be routinely considered when conducting MANPRINT assessments for training devices.

DESCRIPTION: MANPRINT is the process of integrating human factors engineering, manpower, personnel, training, health hazards, and system safety (domains) throughout the materiel development and acquisition process. There are variables within and among those domains which are more important than others in forming a well designed training device when trading off personnel selection, training, and equipment factors. AR602-2 and other Army guidance on MANPRINT requires gathering this type of information which is very difficult to do without some automated systematic method/job aid.

Phase I: Examine relationships between MANPRINT domain variables common to all training devices and devise a strategy for determining the most important ones. Propose a conceptual automated methodology/job aid, embodying that strategy, for analyzing and portraying key variable relationships on a Mackintosh SE/II personal computer.

Phase II: Acquire and analyze data for representative training devices either under or having completed acquisition by PM TRADE with the objective of demonstrating the fully developed automated methodology/job aid originally proposed as a concept in Phase 1. Beta test the computerized methodology.

A91-252 TITLE: Weapons Training Instrumentation

CATEGORY: Exploratory Development

OBJECTIVE: To develop innovative non-intrusive techniques/procedures for monitoring, measuring, and analyzing soldier/crew-weapon interactions and performance.

DESCRIPTION: Even though there are ever increasing numbers of sophisticated and high technology weaponry being fielded in the Army, the role of the Infantry and its set of classical individual and crew served weapons will continue to play both a crucial and fundamental role. Individual and crew weapons training when conducted with a qualified instructor usually produces the desired performance results. Unfortunately, these skills are quite perishable and the availability and quantities of qualified instructors are limited. It is conjectured this problem could be addressed effectively if a non-intrusive embeddable instrumentation/analysis system were available for monitoring/ analyzing appropriate soldier/crew weapon interactions.

Phase I: Develop non-intrusive embeddable monitoring, measuring and analysis approaches for soldier/crew-weapon interactions during both live fire and/or force-on-force engagement simulations exercises. Particular emphasis should be placed on training variables such as sight picture, weapon spatial orientation at time of fire, and the pattern of physical interactions between the soldier/crew-weapon.

Phase II: Design, model, and implement the approach developed in Phase I in sufficient detail to demonstrate feasibility of concept.

A91-253 TITLE: Indirect Fire Weapon Simulation

CATEGORY: Exploratory Development

OBJECTIVE: Develop safe audiovisual cues for indirect fire engagement simulation.

DESCRIPTION: Combined arms maneuver training as conducted at the Army's National Training Center is the finest available in the world. The multiple integrated laser engagement system (MILES) provides a safe technological means for emulating the operation and effects of weapons through a sophisticated transmission and detection pairing system which is keyed to weapon aiming and trigger actuation in the context of engaging a target (detection system). Due to the basic nature of laser transmissions (line of sight) the effects of training cues for indirect fire weapons have not been totally successfully integrated into the force-on-force engagement simulated battle. A new approach or a combination of approaches which are MILES compatible and thrusted at indirect fire weapons issue is needed.

The Army currently has a pyrotechnic based audiovisual cue system which is vehicle mounted or prepositioned. This is considered to be only a partial solution. New efforts should be directed at approach(es) that do not rely on vehicle or prepositioned unit locations for indirect fire audiovisual cues.

Phase I: Develop approach(es) to provide safe audiovisual cues of inbound and impact noise, concussion and debris, flash (night visible), smoke and dust, of indirect fire weapons. Proposed concept(s) should permit direct interaction of the fire support team and the implementation of the indirect fires and the need for real time operation.

Phase II: Design, model and implement approach(es) developed in Phase I in sufficient detail to demonstrate feasibility of concept.

A91-254 TITLE: Simulator Networking

CATEGORY: Exploratory Development

OBJECTIVE: Develop approaches for interconnecting existing simulators with future distributed real time networked simulator environments.

DESCRIPTION: SIMNET, a Defense Advanced Research Projects Agency (DARPA) sponsored project, demonstrated the viability of networked simulators interacting within a common database. Specifications affecting system topology, communication protocols, and data/knowledge bases have been developed and will be utilized to characterize new networked simulation requirements. The cost of new networked simulator acquisitions would be reduced if existing fielded simulators could be efficiently integrated into the networked simulator schema.

Phase I: Develop approaches for interconnecting existing simulators which generally will have different technical characteristics and levels of training fidelity rather than future networked simulators.

Phase II: Design, model and simulate the approach developed in Phase I in sufficient detail to demonstrate the feasibility of the concept.

A91-255 TITLE: Analytical Augmentation of Player Units in a Distributed Simulation Environment

CATEGORY: Exploratory Development

OBJECTIVE: To provide to the commander and his staff a realistic (mathematical) representation of

large unmanned forces that interact on the simulated battlefield with a level of realism similar to that of manned simulations.

DESCRIPTION: The effective use of Simulator Networking as a distributed real time training environment requires large numbers of units to be realistically represented. Realism of performance is not an issue when all simulated units (friend and foe) are manned but that approach is considered impractical for C large scale force-on-force training exercises. The apparent solution to this problem is the development of the capability to simulate (model) the behavior of selected units along with capability to organize and control these units. Ideally, neither the manned simulator players nor some neutral observer could distinguish between the actions of manned and modeled units.

Phase I: Develop approach(es) for simulating (modeling) large unmanned forces that interact with manned components with a level of realism similar to manned simulators. Models should not only capture the operational characteristics of units but must also characterize the salient behaviors of the crews (e.g., route following, obstacle avoidance, use of terrain for cover and concealment, maintaining and changing formations, target detection and acquisition, and rules of engagement).

Phase II: Design, model, and implement approach(es) developed in Phase 1 in sufficient detail to demonstrate feasibility of concept.

N A V Y

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 922
Arlington, VA 22217-5000
(703) 696-4286

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 the problems encountered by the Navy in order to fulfill its mission.

The Navy has identified 77 technical topics in this DOD Solicitation to which small R&D businesses may respond. This is in addition to the 290 topics identified in DOD SBIR Solicitation 91.1 which closed 11 January 1991. A brief description of each topic is included along with the address of each originating office. In addition, there are index and topic title sections which are provided for quick reference. 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.

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 awards funded under any topic and only those proposals considered to be of superior quality will be funded. This year the Navy's SBIR budget was reduced by 25%. While this will not impact funds of Phase I awards that result from the topics listed in this solicitation, it makes it extremely important that Phase I award recipients influence the end uses of the technology since Phase II SBIR funds will be limited and thus highly competitive.

A new participant in the Navy's SBIR Program is the OFFICE OF ADVANCED TECHNOLOGY (OAT). They are responsible for identifying R&D projects, programs or systems which meet critical fleet needs that can be taken to the full demonstration phase. As you read through the topic descriptions you will notice topics that are asterisked after the title. Those topics have been identified by OAT as having the potential to be full demonstration projects.

NAVY SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Submitting Proposals on Navy Topics

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

Topic Nos. N91-291 through N91-297

Administrative SBIR Contact

Mail/Handcarry Address:

Office of Naval Research
Attn: ONR Code 1131M, Room 607
SBIR Program, Topic No. N91____
800 N. Quincy St., BCT #1
Arlington, VA 22217-5000

Dr. D. Polk
(703) 696-0283

Topic Nos. N91-298 through N91-302

Mail/Handcarry Address:

Office of Naval Technology
Attn: ONT Code 20T1, Room 502
SBIR Program, Topic No. N91-_____
800 N. Quincy Street, BCT #1
Arlington, VA 22217-5000

Mr. Doug Harry
(703) 696-4453

Topic No. N91-303

Mail/Handcarry Address:

Office of Advanced Technology
Attn: OAT Code 31, Room 922
SBIR Program, Topic No. N91-____
800 N. Quincy Street, BCT# 1
Arlington, VA 22217-5000

Mr. William Slowik
(703) 696-1299

Topic No. N91-304

Mail/Handcarry Address:

Office of the Chief of Naval Research
Attn: OCNR Code 01221, Room 328
SBIR Program, Topic No. N91-____
800 N. Quincy Street, BCT# 1
Arlington, VA 22217-5000

Mr. Randy Telep
(703) 696-4020

Topic Nos. N91-305 through N91-308

Administrative SBIR Contact

Mail Address:

Commanding Officer
MCRDAC, SBIR Program, Topic No. N91-____
Amphibious Warfare Technology Directorate
Quantico, VA 22134-5080

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SUBJECT/WORD INDEX TO THE NAVY SBIR 91.2 SOLICITATION

TOPIC INDEX
DEPARTMENT OF THE NAVY
FY 1991 SMALL BUSINESS INNOVATION RESEARCH TOPICS

NAVAL SUPPLY SYSTEMS COMMAND

N91-310 Voice Data Entry in NISTARS Warehouses

N91-311 Non-Plastic Substitute for the Plastic Milk Bladder

N91-312 Automated Passenger Order Recognition

NAVAL MEDICAL RESEARCH AND DEVELOPMENT CENTER

N91-313 Lyophilization of Liposome Encapsulated Hemoglobin

NAVAL AIR SYSTEMS COMMAND

N91-314 Antenna & Transmission Line Test

N91-315 Superconductivity Research for Aviation Uses

N91-316 Development of High Temperature Superconductive Systems and Subsystems for Aviation Uses

N91-317 Attack Helicopter Alternative Tail Rotor Applicability

N91-318 Air Vehicle Requirements for Automatic Landing

N91-319 Active Vibration Control For Buffet Alleviation

N91-320 Advanced Integrated Helmet-Display Systems

N91-321 Artificial Intelligence Data Generation Unit

N91-322 Aircrew and Passenger Water Survival Training for the V-22 Osprey Tiltrotor Aircraft

N91-323 Human Factor Considerations for Tactical Aircraft Symbol Sets

N91-324 Multi-Sensor Integration in F-14D Fighter

N91-325 Command Launch Computer (CLC) Improvement Program

N91-326 Exploitation of VHSIC Technology in F-14D

N91-327 Dual Transponder For Ranging and Data Transmission

N91-328 Data Relay System

N91-329 Biodegradable Chaff

N91-330 IR/RF Expendable

N91-331 Single Channel Signal Processor on Minimal Number of Computer Cards

N91-332 Higher Harmonic Control Actuation and Electronic Control System for Navy H-60 Helicopters

N91-333 Electrochromic Materials for Prevention of Cockpit Sunlight Infusion into Aircraft

N91-334 Development of a More Universal Operational Effectiveness Analysis Computer Model

NAVAL SURFACE WARFARE CENTER

N91-335 Aircraft & Cruise Missile Mission and Route Planning Using Near Real Time Pattern Matching Techniques

N91-336 Automated Aircraft & Cruise Missile Mission and Route Planning Using Parallel Constraint-Satisfaction Techniques

N91-337 Real Time Image Processing of LADAR Data for Object/Target Classification

N91-338 Connectionist Model for Automatic Target Recognition Based on the Theory of "Object Recognition by Components"

N91-339 Software Development Process Control

N91-340 Shipboard Weapon System Crew Training

N91-341 Molecular Computing For Automatic Target Recognition

N91-342 Next Generation of High Power Microwave Source

N91-343 High Power Thermal Batteries for Sonobuoys

N91-344 Instrumental Diagnostics for Hypersonic Fluid Mechanics Recognition

N91-345 Two Color Infrared Processors

NAVAL AIR DEVELOPMENT CENTER

N91-346 Multipurpose IR Optical Scanner

N91-347 Long Wavelength Laser Detection System

N91-348 Vision Obscuring Device for Simulated Instrument Flight Training

NAVAL AIR ENGINEERING CENTER

N91-349 Embedded Fiber Optic Sensors for Arresting Gear Cables

N91-350 Personal Computer (PC) Based Eddy Current Probe Characterization and Test Station

NAVAL AIR PROPULSION CENTER

N91-351 Advanced Ceramic Cutting Tools for Titanium Alloys

N91-352 Reducing the Toxicity of Beryllium

N91-353 Innovative, Lightweight, and Long Life Ignition Concepts for Low Pressure Diesel Engines

N91-354 Innovative, Lightweight, and Simple Fuel Filtration Concepts for Small Displacement Diesel Engines

NAVAL AIR TEST CENTER

N91-355 Portable Aircraft Flight Test Instrumentation System

N91-356 Instrumentation System to Measure Ship Motion/Airwake

NAVAL TRAINING SYSTEMS CENTER

N91-357 Knowledge-Based Intelligent Tutoring System (ITS) Development Tool for Tabletop Training Systems

N91-358 Gas Mask Sensor to Detect Whether Mask is Fully Sealed

NAVAL WEAPONS CENTER

N91-359 Develop an Integrated Missile Power Supply and Roll Control System

N91-360 Multiresolution Wavelet Image Tracking

N91-361 High Voltage/High Density Capacitor

N91-362 Replacement Explosive for HNS-IV (HEXANITROSTILBANE)

N91-363 Low Cost Magnetic Heading Reference

N91-364 Low Cost Multi-Spectral Sub-Sonic Radome

N91-365 Electronic Nutation Damping of Free Gyro Seekers

N91-366 Optimized Antennas for Multispectrum Guidance

PACIFIC MISSILE TEST CENTER

N91-367 Application of Mission Support Systems Technology to Navy Fighters

OFFICE OF NAVAL RESEARCH

N91-291 TITLE: Nonlinear Dynamics for Signal Processing

CATEGORY: Research

OBJECTIVE: To employ novel concepts from nonlinear dynamics and fractals to develop new techniques for signal processing and forecasting.

DESCRIPTION: Recent advances in nonlinear dynamics have broadened our appreciation of complex signals by relating chaotic signals to dynamical processes. Ideas of deterministic noise, fractal dimensions, and strange attractors can be useful in detecting complex signals in noisy backgrounds. One may or may not know the signal being sought or one may be trying to forecast natural phenomena. A range of techniques involving embedding dimensions, attractor smoothing, wavelet transforms, stochastic resonance, noise squeezing, periodicity functions, multi-fractals, invariant characterizations, Lyapunov exponents, etc., may be of use. Automated techniques for signal processing which take advantage of modern advances in dynamical systems and fractals are of interest.

Phase I is to identify issues and qualify concepts to demonstrate the viability of novel nonlinear dynamic methods for signal processing.

Phase II would produce devices/software capable of implementing the Phase I concepts.

N91-292 TITLE: High Temperature Transistors (HTT)

CATEGORY: Research

OBJECTIVE: To investigate semiconductors and develop transistor designs for high temperature applications.

DESCRIPTION: Nuclear reactors and turbine engines operated by the Navy could be operated more efficiently if onboard active sensor technology were available. While sensors capable of operating at 325 Celsius are available, the accompanying active electronic devices are not readily available. These devices require a semiconductor having a bandgap of 2.2 electron volts or higher and a compatible metallization technology.

During the Phase I program, a candidate semiconductor capable of sustained 325 Celsius operation will be demonstrated and a transistor design completed.

During the Phase II effort, the transistor would be demonstrated and an operational amplifier would be designed and tested to operate at 325 Celsius and with supply voltages between 5 and 24 volts.

N91-293 TITLE: 4-Dimensional Oceanographic Instrumentation

CATEGORY: Research

OBJECTIVE: To develop innovative instrumentation to measure oceanographic/meteorologic parameters.

DESCRIPTION: Innovative sensors/projectors and measurement techniques are solicited to obtain marine atmospheric, oceanographic (acoustical, optical, physical, biological, chemical, and geophysical) variables in 3D space and time. The emphasis is on (1) novel approaches and concepts for measuring multiple parameters coherently in 4D; (2) new methods of measuring fluxes, acoustic wavefields, or fluid motion of mixtures (i.e. water/bubbles/sediments/biologics). Instruments can be towed/tethered sensors/projectors, elements in arrays, or suites of instruments on ROVs (remotely operated vehicles) to cite a few examples. Low cost, reliable, and/or expendable sensors/projectors and components (e.g. broadband, large dynamic range, high efficiency, compact, low power consumption projector/receivers) are particularly desirable. Full depth capability is desired in instrumentation planned for sub-surface use.

The Phase I proposal should provide a description of exactly what will be measured and to what accuracies and coherence as well as providing the design concept for achieving the measurements. Phase I should produce a proof of concept by demonstrating untested concepts or instruments.

Phase II would develop hardware and demonstrate feasibility in the laboratory. Field testing should be addressed via coordination with ongoing ONR field efforts. Potential approaches to industrial development that transitions program output should also be outlined.

N91-294 TITLE: Remote Environmental Data Link

CATEGORY: Research

OBJECTIVE: To provide user instrumentation for a broadband environmental data retrieval system.

DESCRIPTION: There is a growing need for remote environmental data retrieval systems that link data from surface/sub-surface oceanographic/acoustic sensors at sea to retrieval stations. Plans by Motorola indicate that a large number of broadband satellites could be placed in orbit in the near future that will create a network that can be tapped with cellular telephone technology. Other concepts such as acoustic telemetry, ground wave RF, meteor burst, and error corrected AM offer opportunities for data retrieval.

The Phase I program will design prototype field instrumentation with capabilities for multi-channel temporary storage, data transmission, and reception of instrument command functions to ensure that remote environmental/acoustic sensors can communicate to shore stations. Systems and/or components that are crucial to any/all network approaches can be proposed. Design considerations should emphasize low power consumption and costs. Data message sizes of 100 K Bytes including global positioning and data error flagging and correction are desired. Transmission rates from sensors should be a explicitly defined with desired rates sufficient to accommodate acoustic array data.

Phase II would initiate the plan by developing the transmitter/receiver, global positioning module if appropriate, and temporary storage instrumentation. The probability of Phase II support will be strongly influenced by Phase I findings and external additional support from agencies willing to cooperatively fund early deployment of such instrumentation.

N91-295 TITLE: Identification of Microbially Influenced Corrosion

CATEGORY: Research

OBJECTIVE: To develop identifiers and identifying concepts for microbially influenced corrosion.

DESCRIPTION: Microbially influenced corrosion (MIC) has been recognized for more than 50 years but has frequently been ignored as a significant contribution to the degradation of structural materials. More recently the unexpected corrosion failures of corrosion-resistant materials in relatively benign environments have re-emphasized the importance of MIC, and there is a need to be able to identify MIC by simple and quick procedures. The correct diagnosis is particularly important in situations where preventive treatments for MIC, such as oxidizer additions, are expensive in terms of time, materials, equipment and environmental impact. Presently used techniques for the identification of MIC often rely on the general appearance of the corroded region such as shape of deposits and penetration, characteristic colors and location of attack. These may be followed by sampling, by specialized techniques, of the corroded material and of bulk fluids and by chemical, metallurgical and microbiological analysis. Less time-consuming and less expensive identifying techniques for MIC are much needed by failure analysts.

During the Phase I program, research will address identifying concepts for MIC which are capable of being developed into rapid diagnostic procedures.

During the Phase II effort, the Phase I concept would be further developed and verified in service environments and a diagnostic procedure for the quick identification of MIC will be made available. This diagnostic procedure may be developed as a test kit and/or service.

N91-296 TITLE: Concurrent Design System for Manufacturing

CATEGORY: Research

OBJECTIVE: To develop an integrated system for the rapid design and fabrication of custom parts for use in hydrodynamics experiments.

DESCRIPTION: There is a need for the flexible, rapid and reliable production of physical part prototypes for hydrodynamic experiments. With recent advances in computing technologies, computing theories and manufacturing technologies, it may be feasible to develop an integrated concurrent product/process design system satisfying this need in specific domains. Manufacturing technologies such as stereolithography, selective sintering, plasma coating and others may have the potential for the rapid fabrication of part models. The size of these model parts is less than 0.3 meters in linear dimension. Computing technologies

such as artificial intelligence, computational geometry, robust geometric modelers, and others are emerging as important components of design systems. It is envisioned that an engineering design system built from these technologies will have the capability for synthesis and extensive analysis of product and process designs, for the graphical depiction of the product and process, for the real-time monitoring and controlling of the part production, and the creation of a physical part.

The objective of the Phase I effort is to specify an engineering product/process design system that facilitates the rigorous analysis and formal development from conceptual design through to physical model. The specification should describe: an open-system architecture using a client/server (or object-oriented) model; the human-computer interface and how this interface facilitates product and process design; and the underlying fabrication technology. A description of the operation of the system should be provided. Designs building upon ONR sponsored research in engineering sciences are encouraged.

The objective for the Phase II effort would be the development of an experimental research prototype based on the Phase I design.

N91-297 TITLE: Condition Based Machinery Maintenance *

CATEGORY: Research

OBJECTIVE: To develop methods of detecting small, but permanent, changes in the condition of mechanical systems for the purpose of scheduling preventive maintenance.

DESCRIPTION: Recent developments in signal processing (e.g. wavelets) and the use of new classifiers such as Artificial Neural Networks (ANN) have shown promise for real-time pattern recognition. The vibrational response of machinery changes with the onset and propagation of a component fault. Substantial cost savings can be realized by detection and classification of this abnormality prior to catastrophic failure. This effort will focus on mechanical systems such as gearboxes and bearings in noisy environments as found on ships and helicopters.

During Phase I, research will address the development or identification of signal preprocessing appropriate for filtering diagnostic signal parameters and feature extraction for classification. A rational approach to choice and demonstration of preprocessors combined with suitable classifiers and learning algorithms is desirable. Use of real gearbox or bearing data is preferred, and will be provided by ONR if requested, although use of synthesized data may be acceptable. (This data is not required for proposal submission).

During Phase II, the Phase I system concepts would be further defined and implemented in hardware. In Phase II, a demonstration must be given of the chosen analysis method(s) as applied to a Navy data set and the correlation of the inferred condition with the true state of the mechanical system over its duty cycle.

OFFICE OF NAVAL TECHNOLOGY

N91-298 TITLE: Adaptively Compensated Hydrophones

CATEGORY: Exploratory Development

OBJECTIVE: A miniature piezoelectric hydrophone used in broad bandwidth applications can suffer from a loss in sensitivity due to loading by cabling between the hydrophone and its first preamplifier. A method is needed to minimize this loading effect while maintaining both broad bandwidth and an acceptable level of signal to noise performance.

DESCRIPTION: The Phase I effort should quantify the bandwidth and noise limitations of typical hydrophones both in production and in advanced development. The proposed method to alleviate the problem should be detailed and modeled to ascertain its ability to correct the problem. A sensitivity/tolerance study should be an integral part of the investigation to determine if the method can be reduced to practice. A breadboard circuit should be delivered along with a final report.

The Phase II effort should culminate with the final design and fabrication of a device which could be added to a typical hydrophone for the purpose of increasing its useful bandwidth without reducing the noise performance of the hydrophone. A small quantity of devices would be fabricated and tests undertaken to confirm the predicted performance. The final report would include a complete analysis of the receive subsystem of hydrophone, compensating device, and preamplifier.

N91-299 TITLE: Anti-Reflection Coatings for Use on Ultrahard Conformal Infrared Windows

CATEGORY: Exploratory Development

OBJECTIVE: The aim of this program is to develop materials and deposition processes to fabricate optical thin films to provide anti-reflection (AR) coatings of ultrahard conformal domes with sapphire, spinel or poly-crystalline diamond films for severe high temperature, oxygen-containing environments.

DESCRIPTION: The durability and extremely high thermal shock resistance of sapphire, spinel and poly-crystalline diamond offer a means to protect IR window and dome materials from erosion and environmental attack while improving optical performance, thermal shock resistance and lifetime. Optical quality coatings that can be deposited and adhere to diamond must be developed to provide useful AR coatings that can survive extreme environments. The AR coating should be optimized for transmission in the 8-12 um region. Ideally, it should retain good transmission from the ultraviolet to millimeter wavelengths. A secondary function of the AR coating is to protect the diamond from oxidation by the atmosphere at temperatures up to 1000°C. Optical-quality finishes of about 25A RMS roughness or better will be needed for coated flat and curved surfaces up to 2 inches in diameter. Present diamond abrasive methods are slow, expensive and result in substrate subsurface damage which may limit optical and rain erosion performance. Deposition techniques supplying dense, uniform films will be needed. An emphasis will be placed on scaleable processes. Reflectance and transmittance will be used for optical property measurement. Mechanical properties such as stress, adhesion and thickness uniformity using optical microscopy and scattered light analysis of the films will be determined.

Phases I and II should also address the effects of chemical/mechanical or ion beam finishing techniques on performance and dome cost.

N91-300 TITLE: Reverse Engineering of Assembly Code

CATEGORY: Exploratory Development

OBJECTIVE: To develop an automated approach for the reverse engineering of assembly code.

DESCRIPTION: When the aggregate, integrated, real-time functions of a Navy battle group - carrier, surface combatant ships, aircraft - are modeled, it becomes clear that the U. S. Navy develops and deploys some of the world's largest, most complex information processing systems. The software that battle group operations depend on consists of millions of lines of source code. Many programs are written in computer languages (such as dialects of CMS-2) which support embedded assembly code. During the system life cycle, many software maintenance changes are made. These changes are rarely reflected in the supporting system documentation. This leads to the state where the only true representation of the existing system is the current source code implementation. Reverse engineering provides support for the standard systems engineering process by providing a means for extracting as much high level information as possible to be represented in a detailed design. This high level design information is needed in order to improve maintenance, reduce costs, encourage reuse, and aid in the transition of older systems to new Ada implementations. This research will develop a strategy for automating the reverse engineering process of assembly code. This methodology should integrate to existing development and maintenance environments and automated support tools such as CASE products.

Phase I work should show the feasibility of reverse engineering assembly code for existing systems that are very large and have real-time characteristics. The proposed strategy should documented in an initial report. The requirements and design for a tool to automate this strategy should be available at the end of Phase I.

Phase II work should include the complete development of the automated tool. A test case providing proof-of-concept for the strategy and tool should be completed and documented.

N91-301 TITLE: Design Technique for Automatic Generation of Support Documentation for Large Real-Time Systems

CATEGORY: Exploratory Development

OBJECTIVE: To develop an automated approach for generating documentation (i.e., user's guides, specifications and reports) which provides high level textual representations of systems.

DESCRIPTION: When the aggregate, integrated, real-time information processing requirements of a Navy battle group - carrier, surface combatant ships, and aircraft - are modeled, it becomes clear that the U. S. Navy develops and deploys some of the world's largest, most complex information processing systems.

The development of these systems generally takes several years, requiring the large development teams working together to fulfill the system requirements. Massive documents describing the functionality of the system support the system once it is deployed. These documents are often written early in the development process and can be inconsistent and incomplete with respect to the actual system implementation. Modifications made to these systems after delivery are often not reflected in the supporting documentation.

Some commercial products which generate documentation are available for small or mid-size systems. They cannot handle the large-scale systems used by Navy.

This research will develop a strategy for generating support documentation such as users guides, specifications, and other reports describing the functionality, behavior, and data structure of systems. The proposed strategy should be automatable in order to minimize the time and manpower required to perform the documentation generation. The tool should integrate with existing development and maintenance environments and automated support tools such as CASE products.

Phase I work should show the feasibility of generating documentation for existing systems that are very large and have real-time characteristics. The proposed strategy should be documented in an initial report. The requirements and design for a tool to automate this strategy should be available at the end of Phase I.

Phase II work should include the complete development of the automated tool. A test case providing proof-of-concept for the strategy and tool should be completed and documented using a typical Navy system which will facilitate the transition into the maintenance environment of the Navy.

N91-302 TITLE: Methodology and Tools for Improving the Navy Acquisition Process

CATEGORY: Exploratory Development

OBJECTIVE: To develop methodologies/tools which facilitate the Navy's planning process for acquiring developmental systems.

DESCRIPTION: Various computerized tools have been developed to support the management of technology development and systems acquisition programs, including PERT/Gantt charts and other project schedule/resource management programs and the "what-if" capabilities of spreadsheet programs. A major need exists, however, for additional methodologies and tools to help the Navy plan, evaluate and select Development and Acquisition programs.

Phase I should develop concepts for candidate methodologies and tools, and provide a strong rationale for both (a) the feasibility of implementation of the proposed concepts and (b) the utility of the final product in increasing the effectiveness and efficiency of the Navy's acquisition process.

Phase II would see the refinement of the concepts developed in Phase I and the development/delivery of prototype tools.

OFFICE OF ADVANCED TECHNOLOGY

N91-303 TITLE: Advanced Systems and Technologies for Future Naval Warfare *

CATEGORY: Advanced Development

OBJECTIVE: Enhance Navy's future warfare capabilities in ASW, AAW, STK/ASUW, MIW, AMW, C^3I, EW, Space, Special Warfare, Manpower/Personnel/Training, Medical, Strategic Offense/Defense, Logistics, and Coordinated Battle Force Operations.

DESCRIPTION: Navy is seeking new, innovative, high risk/payoff ideas in technologies and/or advanced systems concepts that support the Navy's mission in the years 2000 and beyond.

Phase I: Proposal should address: a) the system concept or technology being proposed, b) the expected operational utility in future naval warfare, c) description of critical subsystems/technologies, d) required subsystem/technology performance, e) current subsystem/technology maturity, f) the scientific principals involved (show quantitative formulation where appropriate), and g) the work planned to demonstrate technical feasibility and transition of the system into the Navy's acquisition system.

Phase II: Development of the system concept/demonstration of critical components to reduce the acknowledged risk to acceptable levels and transition the proposed system into the fleet at the earliest time.

OFFICE OF THE CHIEF OF NAVAL RESEARCH

N91-304 TITLE: Evaluate and Recommend High Performance Local Area Network Based DBMS HW/SW Configurations

CATEGORY: Advanced Development

OBJECTIVE: Evaluate selected local area network (LAN) based data base management system software against selected hardware to determine high performance and cost effective hardware-software configurations for supporting a multiple platform (LAN, PC, mainframe) cooperative processing environment for business applications.

DESCRIPTION: The need exists to determine whether high performance cooperative processing can cost effectively be achieved using existing LAN based database management systems (DBMS) with hardware such as RISC machines, Unix-based workstations, or 486 processor based machines, plus related peripherals. LAN based DBMS packages include Focus, Oracle, SyBase, and CA-IDMS/PC. The required analysis will involve studying each DBMS with each hardware option to determine workable and optimum high performance cost effective solutions (i.e., hardware/software configurations) for achieving cooperative processing in a multiple platform business application environment. The analysis must also examine the ability of each DBMS to link with CA-IDMS/R VM software located on an IBM 4381 mainframe computer, and determine the feasibility of such a link. First to be evaluated is whether such a solution exists. Second, if there are several solutions, they should be rank ordered and recommendations made accordingly. The study should develop criteria for this rank ordering.

MARINE CORPS

N91-305 TITLE: Bottom Attack Anti-Armor Device (BAAAD)

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop lightweight devices that will give the individual Marine the capability to seriously disrupt armored attacks within tactically reasonable scenarios. Simultaneously, or alternatively, this device would serve as a anti-personnel weapon in a variety of scenarios to include Military Operations in Urban Terrain (MOUT).

DESCRIPTION: The primary mission of the BAAAD is anti-armor. It's secondary capability would be anti-personnel because such secondary capability is easily incorporated in the device to give it more military utility and flexibility. This solicitation attempts to take advantage of new technologies in properly combining energetic explosives, insensitive munitions, lightweight materials, and smart sensors, and programmable fuzes. Exclusive of mines, ordnance and devices to counter tanks and other armored vehicles have focused their attention on attacking the vehicle from directions other than the bottom. The advantages of attacking from the bottom are that protection is minimum and the target area is large. This solicitation envisions the development of concepts that may replace classical hand grenades and concurrently provide a device that is as easily carried and employed which can become a force multiplier in deliberate defense, retrograde, anti-armor ambush, and barrier planning at the company level.

Phase I would consist of concept exploration resulting in a feasibility study, review of current documentation, and a preliminary design study which produces a System Concept Document (SCD), or equivalent. The SCD or equivalent must describe the proposed hardware design to include safeing, arming, sensing, aiming, fuzing, programming, explosive chemistry, armor defeating techniques, and tactical employment flexibility.

Phase II would consist of preparation of detailed design drawings and assembly of the prototype devices. Prototype design will be verified by target engagement testing for effectiveness against simulated personnel targets and armor replicates.

N91-306 TITLE: Electrical Re-Charge System

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop lightweight non-burdensome system that will provide the individual Marine the capability to recharge standard issue batteries in the field.

DESCRIPTION: This solicitation attempts to take advantage of materials technology related to energy conversion and transfer. There are many sources of non-electric energy available to the individual Marine in the field which, if a conversion method were available, he could use to re-charge batteries for such things as radios, lights, optical systems, sensors, etc., thus reducing the logistic train that is now necessary to support those batteries. Sources include the natural movements of the Marine which involves work that is not recovered (piezoelectric generators in boot soles, etc) and chemical energy available in small arms ammunition. This effort is not limited to recharging currently fielded batteries, but may focus on "new" battery materials that would accommodate the requirements of energy conversion rates and techniques required by the solicitation responses.

Phase I would consist of concept exploration resulting in a feasibility study, review of current documentation, and a preliminary design study which produces a System Concept Document (SCD), or equivalent. The SCD or equivalent must describe the proposed hardware design to include materials, principles of energy conversion, storage and use, size and weight estimates, or alternatives to individual devices such as company-level devices.

Phase II would consist of preparation of detailed design drawings and assembly of the prototype devices. Prototype design will be verified by demonstration.

N91-307 TITLE: Micro-Climate Body Temperature Control System

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop lightweight non-burdensome system that will provide the individual Marine the capability to operate effectively physiologically over a broad spectrum of temperature extremes.

DESCRIPTION: This solicitation attempts to take advantage of materials technology related to energy conversion and transfer. Concepts may consider full or partial body coverings that act to regulate the core temperature to within safe limits during heavy workloads typical of wartime military duties in both high and low temperatures. High and Low may be separate solutions. System should sustain the individual for 6 hours. Rejuvenation must be at company level or below.

Phase I would consist of concept exploration resulting in a feasibility study, review of current documentation, and a preliminary design study which produces a System Concept Document (SCD), or equivalent. The SCD or equivalent must describe the proposed hardware design to include materials, principles of energy conversion, storage and use, size and weight estimates, or alternatives to individual devices such as company-level devices.

Phase II would consist of preparation of detailed design drawings and assembly of the prototype devices. Prototype design will be verified by demonstration.

N91-308 TITLE: Optical Scatter Communications

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this topic is to design and develop communications systems which use optical scattering and/or atmospheric absorption to advantage, resulting in short-ranged, low-probability-of-intercept (LPI) tactical communications.

DESCRIPTION: Initial exploratory investigations into the performance characteristics of electromagnetic emissions at near-light frequencies indicate that propagation in this frequency range offers some tactically useful properties. Atmospheric absorption in this frequency range results in very high propagation losses over very short distances, while optical scattering reduces the dependence on optical line of sight between the transmitter and receiver. Several applications are conceivable which would permit omnidirectional, networked communications among voice and data subscribers. Also, by using directional antennas, range can be extended while maintaining other desirable properties. Such a directional system could provide wideband communications point-to-point if a suitable multiplexing scheme could be devised. The current limiting technologies appear to be achieving frequency diversity and the high cost of transmitter and receiver components.

Phase I would consist of concept exploration resulting in a preliminary design study which produces a system design drawing supported by theoretical determinations of system performance. These calculations should verify that the specified performance goals can be achieved.

Phase II would consist of assembly and demonstration of the prototype systems. The demonstration(s) must be designed to verify the theoretical calculations from Phase I.

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

N91-309 TITLE: Tactical Cryptologic Exploitation of Over-The-Horizon (OTH) Radar

CATEGORY: Advanced Development

OBJECTIVE: Explore the feasibility of using tactical cryptologic assets of U.S. Navy ships to take advantage of the back scatter from known Over-The-Horizon (OTH) radars as an enhancement of cryptologic system capabilities.

DESCRIPTION: Tactical cryptologic systems on U.S. Navy ships provide vitally important information in support of the ship's various mission areas by exploiting the electronic emissions of ships and aircraft. Emission Control Measures (EMCON) and other defensive electronic countermeasures are used by opposing force units at sea to nullify or reduce the effectiveness of those cryptologic systems. Land based OTH radars detect and track aircraft and ships at extended ranges by the bistatic processing of ionospheric back-scatter from high power transmissions in the High Frequency (HF) range. Because of the nature of these transmissions and their reflections, it may be feasible for ships equipped with HF radio Direction Finds (HFDF) to establish a line of bearing to reflections from an individual unit.

PHASE I: The Phase I effort should determine the additional benefits if the ship were equipped with its own bistatic processor for the OTH radar pulses and the design of an interface and processor to combine the OTH radar information with the DF information obtained through HFDF.

PHASE II: A prototype of the processor would be developed and tested in Phase II.

NAVAL SUPPLY SYSTEMS COMMAND

N91-310 TITLE: Voice Data Entry in NISTARS Warehouses

CATEGORY: Advanced Development

OBJECTIVE: Emerging voice recognition systems have the potential to improve the productivity of Navy personnel working in warehouse operations.

DESCRIPTION: The Naval Integrated Storage Tracking and Retrieval System (NISTARS) integrates physical distribution operations in a paperless warehouse environment. Issues/receipts, stows and inventories are directed by interactive on-line UNIX workstations linked to a NISTARS central controller (Tandem TXPs) in . NISTARS workstations may be fixed in place at carousel storage, storage/retrieval machines, or at packing and receiving stations; or they may be portable radio frequency hand held terminals, allowing worker autonomy and permitting NISTARS control in remote warehouses. The NISTARS warehouse uses bar code identification with issue documentation printed at a packing station.

Warehouse workers are required to input numerous simple keyboard entries while using NISTARS, e.g., "Y", "N", "[Entry complete]", "[Task complete]", and "[type in quantity]". During the stow/issue process the workers must set aside material being handled in order to utilize workstation keyboards. This process costs several seconds per data item entered multiplied by several thousand times per day, equates to many hours of lost productivity.

Implementation of an effective voice data entry technology, reducing keyboard data entry, could reduce response time in providing materials and services to the fleet and improve productivity of the warehouse worker. Voice data entry would be especially useful in cold storage warehouses, where heavy gloves make keyboard data entry cumbersome. NISTARS fixed workstations at various Naval Supply Centers are either 80286 or 80386SX chip based computers and use the SCO Xenix operating system. Hand held terminals are Teklogix model 7015.

Contractor can expect to visit a designated Naval Supply Center and the Naval Fleet Material Support Office, Mechanicsburg, Pennsylvania.

Phase I should provide a feasibility study which includes the cost benefit analysis and implementation methodology of incorporating voice data entry technology into the existing NISTARS application software and workstation hardware--all of which is Government owned.

N91-311 TITLE: Non-Plastic Substitute for the Plastic Milk Bladder

CATEGORY: Advanced Development

OBJECTIVE: To develop an operationally and environmentally acceptable substitute for the plastic milk bladder currently used in all military and institutional food service systems. This new milk bladder would assist the Navy in meeting the objectives of Public Law 100-220 and the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) banning the overboard disposal of plastic wastes.

DESCRIPTION: Due to legislation which bans the disposal of plastics into the sea, the U.S. Navy is looking for substitutes for high volume plastic items currently used aboard Navy vessels. Food related plastic waste poses the most serious problem since it becomes both an odor and potential health problem when stored. The plastic milk bladder has been identified as a priority target for replacement. Market surveys have not yet yielded an acceptable substitute for this item. An acceptable solution is an environmentally friendly, non-plastic, bulk container, that can be disposed of by standard shipboard practice. The container shall comply with the guidelines in CID-A-A-20113B for Milk and Milk Products dated 12 December 1986.

Anticipated travel requirements: 1 trip to Natick, MA; 1 trip to Norfolk, VA; 2 trips to Washington, DC.

Phase I: Survey of emerging technologies and solicitation of novel ideas that meet the requirements previously stated. Evaluation of the environmental acceptability, industry acceptability and economic feasibility, given Navy's current system and demand.

Phase II: Development and field testing of an acceptable milk bladder.

N91-312 TITLE: Automated Passenger Order Recognition

CATEGORY: Advanced Development

OBJECTIVE: To develop an optical scan or holographic recognition system for in check processing of DoD travel orders (computer generated by all Services) using a common bar code which will contain all data fields in PCS/TAD/TDY orders.

DESCRIPTION: Cargo checked for airlift movement within the MAC airlift system is now processed using bar codes with radio transmission to on-site central computers using newly fielded handheld terminals (HHT's). Passenger processing is still accomplished by laborious manual input into the MAC PRAMS computer system despite the fact that nearly all travel orders are computer generated. The nature of flight schedules often causes large lines of travelers who must be individually processed under the current methods to gain seat assignment. Interpretation of priority based on the nature of the traveler's orders or leave papers takes time and can frustrate customers. This process needs to be streamlined to avoid processing delays and traveler frustration. Manual processing will always have to be an option in case bar codes are obliterated or missing. Coordination with HQ Military Airlift Command, Scott AFB, Illinois (code TRQ) is required for eventual software development in the MAC passenger system (PRAMS) to allow recognition of the bar codes and instantaneous determination of seating priority or qualification. (Source: MAC Regulation 76-1, chapter 14 and DoD Regulation 4515) One trip to Norfolk, Virginia (NAVAIRTERM and PSD, Norfolk); One trip to HQ MAC, Scott AFB, Illinois and possibly a trip to AF computer design center (PSD Crystal City can also advise utility of concept to order issuance for Navy).

Phase I: Survey of Navy Personnel Support Activity to verify efficiency of creating required orders with bar codes (codes could also assist PSD system). Also survey civilian airline practices now in effect for using bar coding of purchased tickets to check in and issue boarding passes. Development of recommended system description responding to survey.

Phase II: Development and field testing of the system (with HQ, MAC) concurrence and simultaneous software development necessary in the PRAMS system.

NAVAL MEDICAL RESEARCH AND DEVELOPMENT CENTER

N91-313 TITLE: Lyophilization of Liposome Encapsulated Hemoglobin

CATEGORY: Exploratory Development

OBJECTIVE: The proposed objective of this topic is to develop methods for large-scale lyophilization of the liposome encapsulated hemoglobin (LEH) consistent with GMP standards.

DESCRIPTION: LEH has been developed by the Navy as an oxygen-carrying fluid. During storage, at four degrees Celsius in liquid, the hemoglobin slowly oxidizes to the methemoglobin form. Storage stability can be enhanced by fabrication and lyophilization of the LEH in the presence of disaccharides. We desire the development of manufacturing procedures for making multiliter quantities of LEH containing disaccharides and lyophilizing the material under carefully controlled conditions. It is essential that sterility of the LEH be maintained throughout the procedure.

NAVAL AIR SYSTEMS COMMAND

N91-314 TITLE: Antenna & Transmission Line Test

CATEGORY: Exploratory Development

OBJECTIVE: Develop end-to-end built in test/fault isolation and detection (BIT/FID) for antennas and associated transmission lines that will isolate to a single point failure with 98 per cent accuracy.

DESCRIPTION: Current testing of communications systems and electronic counter measures requires external test equipment. These external equipments are bulky, labor intensive to operate, and require extensive logistic support. For aviation units deployed aboard ship they present a storage and space problem. External tests are accomplished on a periodic inspection cycle that does not provide operators with high system confidence. Therefore, there is a requirement for BIT/FID to eliminate the requirement for external test equipment. and to provide preflight verification of antenna and transmission line continuity across any given width. If faults are detected, BIT/FID must isolate the fault so it can be repaired quickly without the use of external troubleshooting aids.

Phase I - Concept design and evaluations.
- Breadboard construction and demonstration.

Phase II - Concept development.
- Brassboard construction and system demonstration.

N91-315 TITLE: Superconductivity Research for Aviation Uses.

CATEGORY: Research

OBJECTIVE: To investigate and make specific recommendations concerning the supportability of emerging high temperature superconductor hardware sub-systems and maintenance and support techniques, practices and procedures to be used and supported in avionic systems in fleet use. Efforts will also focus on reliability predictions.

DESCRIPTION: Currently, extensive research is being conducted concerning the design and performance of superconductors in avionic systems. It is conceivable that within the next six years aviation systems containing superconductors will enter fleet use. To date, sufficient research has not been conducted to determine how superconductors will be supported and maintained once they are introduced into the fleet. If a supportable product is to be delivered to the fleet, research of this type must be conducted immediately or we lose the opportunity to influence current and emerging superconductor designs.

Phase I shall consist of a general research study of the specific areas of the design, maintainability, testability, and support needs for high temperature superconductors. At the completion of Phase I, the government will receive a summary, conclusion, and recommendations for each area covered.

Given favorable results from Phase I, Phase II shall be a more in-depth research including experiments and field studies to make specific recommendations regarding types of high temperature superconductors and delivery of logistic support analysis products.

N91-316 TITLE: Development of High Temperature Superconductive Systems and Subsystems for Aviation Uses

CATEGORY: Exploratory Development

OBJECTIVE: Devise, design, and demonstrate technology applications for high temperature superconductors for use in aviation applications that will improve system reliability.

DESCRIPTION: Power consumption, space, and weight are restricting factors in aircraft design that have overshadowed reliability requirements in the past. The advent of high temperature superconductors will offer relief, in some applications. Increased life span of aircraft and subsystems is a driving factor in the requirement for higher reliability in future aircraft design. Innovative applications of high temperature superconductors that will increase reliability in Naval Aviation are requested.

Phase I: During this phase, innovative concepts will be recommended and feasibility established via mathematics, computer simulation, prototyping or a combination of these.

Phase II: Using the results of Phase I the contractor will develop and demonstrate the high temperature superconductor applications proving increased reliability of the system or subsystem.

N91-317 TITLE: Attack Helicopter Alternative Tail Rotor Applicability

CATEGORY: Advanced Development

OBJECTIVE: Investigate feasibility of modifying AH-1W attack helicopters employing alternative tail rotor concepts. Explore technology to allow integration without creating major airframe design changes.

DESCRIPTION: The US 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. This effort will focus on employing alternative tail rotor technology to yield an attack helicopter which is more maneuverable, quieter, and less susceptible to battle damage. Feasibility investigations should examine all capabilities of current airframe configurations, as well as address the following: 1. Systems integration. 2. Composite material technology. 3. Noise signature. 4. Ability to land in unimproved areas such as forests. 5. Maintainability enhancements such as reduction in parts, wiring and mechanical devices. 6. Overall survivability of the aircraft. 7. Stability in rapid turn-around maneuvers versus drag penalty. 8. Optimized vertical/horizontal stabilizer configuration for high-speed forward flight.

Phase I is envisioned as a feasibility/design study exploring incorporation of the improvements discussed above. Phase II of this effort would focus on developing a conceptual design.

N91-318 TITLE: Air Vehicle Requirements for Automatic Landing

CATEGORY: Exploratory Development

OBJECTIVE: Establish a methodology to determine the control system requirements for automatically landing an air vehicle in the 200-10,000 lbs class onto the deck of a small ship.

DESCRIPTION: Control system requirements and specifications need to be defined for automatically landing unmanned air vehicles onto the decks of Navy ships. Current retrieval methods such as landing into a net or wet landings at sea are often difficult and can cause damage to the vehicle. An automatic landing onto the deck would eliminate these deficiencies. However, a methodology is first needed to determine the significant parameters and their acceptable ranges to ensure that the air vehicle is agile enough to automatically land on the moving deck of a small ship in various sea states. Parameters such as control power, side force generation, desired vehicle accelerations, etc. need to be defined for combinations of air vehicle gross weight and sea state.

Phase I would include a survey of current techniques used to land unmanned air vehicles on small ships and an evaluation of the significant parameters involved. A methodology would be developed and applied to evaluate the landing requirements for air vehicles in the 200-10,000 lbs range.

Phase II would apply the guidelines developed to an actual air vehicle under design.

N91-319 TITLE: Active Vibration Control For Buffet Alleviation

CATEGORY: Exploratory Development

OBJECTIVE: To develop advanced active control concept for application to buffet relief in twin vertical tail tactical aircraft.

DESCRIPTION: A concept is required to alleviate tail buffet which is encountered at high angle-of-attack and maneuvering flight conditions. With the advent of higher agility for future tactical aircraft the current tail buffet issue will only become more pronounced and will reduce the aircraft's maneuvering performance as well as service life.

An innovative approach to alleviate tail buffet throughout the entire flight envelope, which now includes the post stall flight regime, is needed. The objective of this topic is to apply flight control technology using the existing aircraft surfaces or possible auxiliary aerodynamic surface modifications to the vertical tail, to actively control the tail surface vibrations.

Phase I would include a survey of prior applications of active flight control technology to buffet alleviation or similar application. This phase would also include a feasibility study of the proposed solution with some experimental demonstration desirable.

Phase II would likely comprise the development of the proposed solution for experimental verification and demonstration.

N91-320 TITLE: Advanced Integrated Helmet-Display Systems

CATEGORY: Exploratory Development

OBJECTIVE: To conduct essential literature reviews, empirical research, operational analyses and technology assessments in order to establish design and acceptance criteria, and a lessons-learned database, for a performance- optimized, multi-mission, advanced integrated helmet-display system. Results will be used to support concepts for an advanced integrated system that capitalizes on new technology, provides full threat protection, (i.e, Laser protection, crash protection, escape/ejection safety), as well as enhanced capabilities for night vision and other sensor integration, improved data interface, complete inter- and intra-aircraft usability, compatibility with other man-mounted systems, improved off-boresight capability with reduced complexity (not requiring cockpit mapping), and reduced transmissivity burdens within the cockpit "canopy-to-eye optical chain". Principal areas include Human Engineering, Display and Life Support System Integration, Mission Analyses, and Escape Engineering.

DESCRIPTION: Current Helmet-Mounted Displays (HMDs), for use in both fixed and rotary wing air vehicles, have not successfully demonstrated their capabilities in view of safety, mission and user needs. Further, there is little research data to substantiate optimal human interface and aircraft integration characteristics of such systems. Analyses, research, and assessments are needed to investigate existing issues and establish firm design criteria for an advanced system. Reviews will be performed on available literature (e.g. human visual interface to displayed data, optimal FOV and display of concurrent scenes of real world and sensor generated data, helmet design qualities and operational usage characteristics, NVIS and helmet user interface improvements, NVIS operational data, mishap and accident data, and current HMD evaluation results). A function analysis will be conducted on a notional advanced system design to orient research and eventual criteria. Analyses will be conducted on aircraft and life support integration issues, threat protection impacts, aircraft escape systems and fixed/rotary wing missions as they pertain to HMD design criteria. Essential research will be conducted on issues associated with display interfaces, human use during escape and others where insufficient data exists. New and emerging technologies will be assessed to document potential advancements that can be achieved in a future integrated system, in view of the various requirements above and the criteria established by the results of research/analysis efforts. Results of all work will be used to develop a "lessons learned" database, and to document criteria and recommendations for the design and evaluation of an advanced integrated system. Examples of research issues can be obtained from NAVAL AIR SYSTEMS COMMAND (AIR-05TE).

A comprehensive report will be delivered at the end of Phase I defining approaches, plans, schedules, facilities, data sources, research issues, initial findings and other supportive efforts.

Phase II: Should provide sufficient research/analysis data to substantiate evolving criteria. At the end of Phase II reports will be delivered for each of the major efforts and products defined above.

N91-321 TITLE: Artificial Intelligence Data Generation Unit

CATEGORY: Advanced Development

OBJECTIVE: Artificial intelligence data generation unit for engagement training aids

DESCRIPTION: Engagement training aids have been developed and deployed at fleet operational sites that take full advantage of Z-248/Z-386 architecture and provide state-of-the-art scenario simulation for a variety of ordnance weapon systems. A requirement exists to explore development of an artificial intelligence data generation unit for the engagement training aid that would further increase its system capabilities to simulate mission scenarios.

Phase I should consist of a general research study covering specific options and designs for the system. At completion of Phase I, the government will receive a summary, conclusion, and recommendations for each option and design study.

Phase II should be more in-depth research including prototype experiments and possible development of prototype systems for further evaluations.

N91-322 TITLE: Aircrew and Passenger Water Survival Training for the V-22 Osprey Tiltrotor Aircraft

CATEGORY: Research

OBJECTIVE: To assess the V-22 water survival training requirements with regard to the aircrew and its passengers by comparing them with those of helicopters and other passenger carrying aircraft and to recommend a method of training for this Vertical/Short Takeoff and Landing (V/STOL) aircraft.

DESCRIPTION: The U.S. Navy is currently developing the Osprey for the U.S. Marine Corps for its medium air assault weapons system whose primary mission will be to transport combat troops and cargo of the landing force to forward areas. The V-22 Osprey will be the world's first production aircraft with proprotors installed in tilting engine nacelles. With its proprotors in the horizontal position, the V-22 can takeoff, hover, and land like a helicopter. Once airborne, the V-22 can transition into a fixed wing forward flight mode aircraft. The uniqueness of this aircraft and its flight characteristics has introduced questions as to the adequacy of currently used water survival training systems. The contractor will use the following documents in preparation of the study:

MIL-T-23991E	General Specification for Military Training Device
MIL-T-29053B	Requirements for Training System Development
MIL-STD-1379C	Military Training Programs

Phase I: Provide an assessment of the V-22 water survival training requirements for aircrew and passengers. Compare the requirements with those currently in existence for helicopter aircrew and passengers and make recommendations as to how the difference can be addressed.

N91-323 TITLE: Human Factor Considerations for Tactical Aircraft Symbol Sets

CATEGORY: Research

OBJECTIVE: Define symbol sets optimized for human factors considerations for display of information in tactical Navy aircraft. If successful, the optimized symbol sets will allow tactical information to be displayed in a more concise, readable format, greatly reducing aircrew workload and enhancing tactical capability.

DESCRIPTION: A wide range of information is available to the aircrew of modern tactical aircraft. This includes data from on-board sensors such as radars, infrared search and track systems, and television camera systems; ECM data; IFF data; and information from other platforms via data link networks. Displays to present the data include Heads Up Displays (HUDs), raw radar displays, dedicated tactical displays, and Multi-Function Displays (MFDs). The latter will soon have the capability to display data in color. The approach to date has been primarily to layer additional data displays onto current ones using minor variations of existing symbol sets. The result has been an exponential growth of the data displayed to aircrew with the potential to saturate them with more information than can be easily interpreted and understood. A fresh approach to the problem of displaying tactical information - one based heavily on human factors considerations - will enhance the ability to operate in the modern tactical environment.

Phase I will define an approach to present tactical information on the F-14D as a representative aircraft; the approach will:

- o Define how to distribute information among available displays.
- o Define proposed symbology (size, color, placement of symbols).
- o Define the display of information updates and track confidence levels.

Phase II will code and demonstrate a simulation of the proposed symbology. For purposes of the simulation, manual inputs (e.g., keyboard entries) for target parameters and information updates (e.g., data link, target maneuvers) will be permitted. The simulation should include provisions to provide hard copies of selected runs for evaluation by Navy F-14 flight crews.

N91-324 TITLE: Multi-Sensor Integration in F-14D Fighter

CATEGORY: Exploratory Development

OBJECTIVE: Define algorithms for tracking and targeting airborne threats using multiple sensor sources.

DESCRIPTION: Modern tactical aircraft have the capability to track or target airborne threats using more than one sensor. The most advanced example of this capability is the F-14D aircraft, which can track targets - independently or in combination - with the APG-71 radar, the Television Camera Set (TCS), or the InfraRed Search and Track System (IRST). Additional target information is also available through on-board ECM systems and even through other platforms using aircraft-to-aircraft and ship-to-aircraft data links. Unfortunately, tactical software has not kept pace with the capabilities inherent in having a wide range of available sensor sources; current software focuses on sensor sources as independent trackers rather than as part of an integrated data fusion package. Recent advances in neural networks/artificial intelligence provide the potential to define tracking schemes using multi-sensor integration. Such an approach can provide the capability to passively track and target airborne threats, presenting a significant advancement in tactical flexibility. This project would use the sensor data available to the F-14D as the basis to develop:

- o An automated data fusion tracking algorithm for multiple targets, including the optimum use of active (radar) data.
- o A semi-passive tracking algorithm (active sensor data intermittently available).
- o A passive tracking algorithm

The project would require access to classified information on F-14D sensor capabilities.

Phase I: Provide information to the contractor on the parameters of F-14D sensor data, nominal initial target acquisition parameters and allowable target maneuvers (speed, altitude, heading changes) after acquisition. Define the approach for developing all three algorithms (active, semi-passive, and passive), starting from a time slice/initial condition basis and proceeding to a time dependent basis (i.e., sensor utilization to maintain track using predicted target position). The approach should address schema to show track confidence levels.

Phase II would define the algorithms in ADA and write appropriate device drivers to demonstrate a simulation using the algorithms.

N91-325 TITLE: Command Launch Computer (CLC) Improvement Program

CATEGORY: Engineering Development

OBJECTIVE: To reduce parts count, printed circuit board card quantity, and card size of the HARM Anti-Radiation Missile Command Launch Computer.

DESCRIPTION: The HARM missile is interfaced to aircraft platforms using a Command Launch Computer (CLC). The CLC is a 1970's Texas Instruments design containing over 1200 Integrated Circuits (IC). The result is an avionics box which is large and heavy by modern standards, and difficult to integrate into aircraft because of that size. This project would examine the product baseline list (PBL 704AS5951), Prime Item Development Specification (AS 5015), and Prime Item Product Specification (AS 5080) to combine current CLC 1970's memory and IC functions into smaller, more efficient integrated circuits. The reduction in parts count, card count, power requirements, and weight will benefit existing CLC users. It will also provide capability for alternative CLC implementations for future efforts to integrate HARM capability into additional aircraft types.

Phase I should be a study to identify current combinations of ICs which could be combined using existing off-the-shelf components. It should also provide a preliminary study to identify additional components which could be combined if IC redesigns were available.

Phase II should use the approach identified in Phase I to produce breadboard equivalents of combined functions using off-the-shelf components, and to produce the designs (but not necessarily the hardware) for proposed new IC hardware.

N91-326 TITLE: Exploitation of VHSIC Technology in F-14D

CATEGORY: Engineering Development

OBJECTIVE: Define F-14D architecture and software changes which will take advantage of enhanced capabilities inherent in XN-8 AN/AYK-14 processor modules; successful completion will define software / architecture changes which can yield higher throughput and increased tactical capability for F-14D aircraft.

DESCRIPTION: Very High Speed Integrated Circuit (VHSIC) technology has lead to enhanced performance XN-8 AN/AYK-14 processors, currently under test. By their design, XN-8 modules have greater memory and the potential for greater speed than existing AYK-14 modules. That potential, however, has yet to be realized in an actual application. Integration efforts to date have centered on VHSIC processors as "drop-in" replacements of existing processors. The contractor would be provided with detailed specifications of the current F-14D architecture and bus traffic, plus specifications for the XN-8 processors. The contractor should be familiar with MIL-STD-1553 bus protocols.

Phase I would define an approach to distribute processing between XN-8 Mission Computer and back-up Mission Computer AYK-14 modules of the F-14D, and recommended key performance parameters.

Phase II would develop benchmark tests which could be used to compare existing F-14D systems with VHSIC based systems in those key performance parameters identified in Phase I. Ideally, this phase should be coupled with an actual demonstration; this would require Navy provided laboratory facilities and processors to be used in the comparison.

N91-327 TITLE: Dual Transponder For Ranging and Data Transmission

CATEGORY: Engineering Development

OBJECTIVE: Develop a dual frequency transponder to replace two existing units which are used by aircrews during fleet training exercises.

DESCRIPTION: Navy training and tactics development exercises employ tracking and data relay systems to provide exercise scenario control, range safety, data collection for exercise reconstruction and combat crew debrief. The Mobile Sea Range (MSR) system employs a relay, reporter, responder (R-cubed) transponder with a center frequency of 141MHz, while land-based aircrew training ranges employ a Tactical Aircrew Combat Training System (TACTS) transponder with a frequency of 1840MHz. These transponders may be housed in an external pod similar to an AIM-9L missile or installed internally to the applicable aircraft. Training requirements necessitates that MSR and TACTS aircrew training be conducted back-to-back without debrief. This requires the use of both transponders while training on the MSR and TACTS ranges. Limited external pod space and the need to reduce costs are the primary requirements for a single dual frequency transponder that can support the MSR and TACTS ranges.

Phase I: Design a dual frequency transponder with a target of 108 cubic inch volume excluding connectors and antennae. The 141 MHz section must have a peak power output of 200 watts and the 1840 MHz section must have a peak power output of 25 watts. The noise figure is to be no more than 3 dB. The design should entail card layout and manufacturing technology to be used.

Phase II: Develop and provide a breadboard to demonstrate the Phase I design. Develop a transponder prototype to validate the mechanical design and system performance requirements. Develop three (3) qualification units which will represent MIL quality components and manufacturing techniques. Perform in plant testing to validate the system performance requirements and provide support to the government on-site test program.

N91-328 TITLE: Data Relay System

CATEGORY: Engineering Development

OBJECTIVE: Develop a data communications system to provide a secure data relay for Global Positioning System (GPS) position, platform sensor, and weapons event data from a large number of fleet exercise participants over an extended open-ocean environment.

DESCRIPTION: The current Navy at-sea battle training system uses a position location and participant data relay system for real-time scenario control, range safety, and post exercise reconstruction. This system operates at 141 MHz to provide coverage over the operational area necessary for exercise "free play". Future at-sea battle training systems require enhanced participant position location using the GPS and increased data transmission rates. A secure data communications system operating at 141 MHz with a 4 MHz bandwidth in consonance with the characteristics of the approved frequency allocation must be developed to

provide data relay for position location, on-board sensors, and weapon system data. The system must support training exercises in which up to 100 air and surface units will be instrumented for data relay. A design goal should be optimization of participant data handling capacity. One approach to be considered is the use of modules from existing Relay, Reporter, Responder (R-cubed) transponders.

Phase I: A paper design is required with supporting computer simulations which can be used to demonstrate communications system performance requirements. Transponder packaging to accommodate a GPS receiver should be also examined. The design should consider potential interference to and from narrow band Frequency Modulation Continuous Wave communications systems operating in the same band during the training exercise.

Phase II: A breadboard unit is to be developed and tested. A test bed using existing Navy R-cubed units should be considered. An engineering development model (EDM) is to be implemented and tested. This EDM should include a master station and ten (10) transponders. Computer simulation should be used to demonstrate a fully stressed communications system.

N91-329 TITLE: Biodegradable Chaff

CATEGORY: Exploratory Development

OBJECTIVE: Provide a substitute material which is biodegradable for the current metalized-glass used for electromagnetic reflecting materials (chaff). If successful that material will replace the glass portion of the metalized-glass for use as chaff.

DESCRIPTION: Currently chaff is used by armed forces for confusing threat radar systems. The U.S. Navy uses metalized-glass cut to pre-determined lengths for this function. Current environmental impact studies have shown metalized-glass to be benign; however, due to chaff's persistence and the unpredictability of environmental standards it is appropriate to seek biodegradable alternatives.

During Phase I it is expected that the contractor will deliver: (1) a final report outlining the approach which will be undertaken to mass-produce the material, and (2) a quantity (2 to 4 lbs) of the material in 1" lengths by 1 mil thick for military testing. It is expected that this contract will require access to classified information upon awarding a Phase II contract. The Navy will assist in acquiring the needed facility clearance when required.

N91-330 TITLE: IR/RF Expendable

CATEGORY: Exploratory Development

OBJECTIVE: Provide an expendable device which will combine infrared (IR) and radio-frequency (RF) countermeasure capabilities in a single expendable.

DESCRIPTION: Currently U.S. Navy aircraft use separate expendables for IR and RF threats. This drives a requirement to either identify the threat or use both types. In the first case this is done by an expensive warning system and in the latter case an early expenditure of limited on-board assets. If one expendable could be devised for both threats with equal effectiveness, then both cost avoidance and increased effectiveness would result. The planning size constraint of the expendable is; 1-5/8" diameter by 10-1/2" in length. The IR/RF signatures sought are 1,000 watts/steradian in the 2-3 micron IR and 10 square meter of radar cross-section in the 8-10 GH_z spectrums.

During Phase I the contractor will be expected to evaluate alternatives and deliver a report outlining the concept chosen and their approach in implementing that concept to satisfy this requirement with sufficient data to demonstrate feasibility.

It is expected that this contract will require access to classified information upon awarding a Phase II contract. The Navy will assist in acquiring the needed facility clearance when required.

N91-331 TITLE: Single Channel Signal Processor on Minimal Number of Computer Cards

CATEGORY: Exploratory Development

OBJECTIVE: Design single channel modular acoustic processor capable of performing all required processing and data storage for any sonobuoy type in any selected mode based on state-of-the-art hardware using a minimum number of computer cards.

DESCRIPTION: The Navy is looking for innovative ideas relative to design of a single channel modular acoustic processor capable of performing all processing functions and data storage for all types of sonobuoys.

Phase 1 of the study will define a processor to perform the following functions: (1) Hold and execute all processing and data control software - for input signal conditioning, beam forming, signal processing and display formatting. (2) Hold and format on demand all data required in the draft ASUTTA performance specification (includes 20 minutes of passive data, DIFAR (Orthogonal cardioids), or 6 pings of active data (ERAPS)). The ASUTTA spec is available at the SBIR office. (3) Have a reconfiguration time, between processing modes, of less than 2 seconds without impact on any other concurrent processing.

Phase 2 of the study will: (1) Identify the primary issues involved in developing the processor and evaluate alternatives and trade-offs in system design. (2) Provide an estimate of feasibility, capability and cost of any ASW aircraft acoustic processor upgrade using the modular processor. (3) Build and demonstrate a prototype processor. The system will be demonstrated using a fleet mission tape provided by the SBIR office.

N91-332 TITLE: Higher Harmonic Control Actuation and Electronic Control System for Navy H-60 Helicopters

CATEGORY: Advanced Development

OBJECTIVE: Design/develop a Higher Harmonic Control (HHC) actuation system and its control package which will allow for the transfer of 4P actuator loads from the fixed frame into 3P, 4P, and 5P in the rotating frame of a Navy H-60.

DESCRIPTION: Helicopter rotor motion amplitude and phase alteration with HHC can be used to reduce fuselage vibration, lower aircraft power required, and alter the helicopter acoustical signature. Using the filtering properties of a helicopter rotor, the higher harmonic content ((N - 1)P, NP, and (N + 1)P) of the rotating vertical and inplane shears can be greatly suppressed through cancellation with the non-rotating vertical shears at NP.

The HHC system should incorporate high frequency hydraulic actuators which have no phase shift throughout the required frequency range and are adaptable to the Navy H-60's hydraulic system. The electronic control system should consist of an electronic control unit, a digital controller, and a control panel. The electronic control unit should interface the sensors with the digital controller or microcomputer. The control panel should provide an interface between the flight crew and the electronic control unit. Sensors are required to measure NP accelerations, rotor torque, and engine shaft pressure. Control of actuator amplitude and phase should be closed loop employing modern multi-input/multi-output state variable techniques for optimum response.

Phase I: Review previous HHC related work and develop preliminary design, using an innovative approach, for HHC actuation and control system and sensor package. Also, provide an initial estimate of performance increase using HHC on a Navy H-60 helicopter.

Phase II: Complete HHC system design, and develop and install the HHC system on an H-60 helicopter at the Naval Air Test Center (NATC). Provide an HHC failure analysis, a system simulation, and design and support a flight test program complete with sensor calibration and data reduction to show the effects of HHC on performance, acoustics and vibration.

N91-333 TITLE: Electrochromic Materials for Prevention of Cockpit Sunlight Infusion into Aircraft

CATEGORY: Exploratory Development

OBJECTIVE: To develop electrochromic materials that can prevent sunlight from washing out color multifunction displays (MFDs) and can also reduce the greenhouse effect in modern aircraft. Many of the new Navy aircraft such as the V-22 and F/A-18 utilize color MFDs which are easily washed out by strong sunlight penetrating the canopy. Current electrochromic materials do not meet all requirements needed to solve the problem.

DESCRIPTION: A method of reducing light entering the cockpit is to use electrochromic materials, preferably integrated into the canopy of the aircraft, to control the amount of light falling on the displays. The major advantage of electrochromics is that pilots can control the transmission of light into the cockpit for desired light levels. A number of the materials available come close to meeting the requirements for this type of application. Every material investigated to date fails at least one or more important parameter that prevents it from being suitable.

The purpose of this project is to find one or more new materials that would meet all of the major requirements. These requirements are: maximum transmission, 70% minimum (85% goal); maximum/minimum transmission ratio, 10 (100 goal); control voltage, less than 5 volts dc (less than 2 volts dc goal); fail safe, 0 volts dc (or shorted) for bleached; time constant, less than 5 seconds for 90% point each way (less than 1 second goal); temperature, operating range -10 degrees to 55 degrees C (-40 degrees to 70 degrees C goal); temperature, storage -55 degrees to 90 degrees C (-65 degrees to 100 degrees C goal). Material shall be long-term stable, and not deteriorate with ultraviolet radiation. In general, the material shall meet the requirements of MIL-E-5400.

Phase I should consist of identifying materials and selecting promising candidates which have the characteristics indicated above.

Phase II should use the materials identified in Phase I for testing to determine material characteristics. Three samples of each suitable material, 10 cm square (with 30 cm as a goal) shall be delivered to the government for testing.

N91-334 TITLE: Development of a More Universal Operational Effectiveness Analysis Computer Model

CATEGORY: Exploratory Development

OBJECTIVE: Investigate and demonstrate expanding an existing computer-based operations effectiveness model to analyze the spectrum of modern warfare from engagements to campaigns.

DESCRIPTION: Operations analysis (OA) models have traditionally been developed and implemented independently by the agencies or programs requiring specific platform unique analysis. As a result of processing limitations imposed by hardware, OA models have been scoped to a particular level of conflict in order to achieve fighter simulation fidelity. This limitation requires either a series of models, analyst assumptions or both to analyze weapon systems, strategies and tactics in context with other units or forces. Most OA computer models utilized by government agencies have not kept pace with weapon system developments nor are they readily expandable or exportable for use on evolving computer systems. This situation leaves government analysis organizations with a fragmented capability to simulate the many aspects of warfare scenarios.

This effort is designed to expand a modular, portable analysis tool designed for parallel processing into a selectable fidelity, full-spectrum model to serve as a "common denominator" among the specialized computer-based analysis facilities. It is intended to interact in parallel with related models for large-scale simulation as well as provide stand-alone excursion analysis for decision makers.

Phase I - Research existing models to identify the best candidate for consolidation and expansion. Develop software to demonstrate the degree of the model(s) growth potential.

Phase II - Develop, test and run generic software to model and analyze the operational effectiveness of strategic and tactical units in a total force context.

NAVAL SURFACE WARFARE CENTER

N91-335 TITLE: Aircraft & Cruise Missile Mission and Route Planning Using Near Real-Time Pattern Matching Techniques

CATEGORY: Exploratory Development

OBJECTIVE: Devise a concept for near real-time derivation of aircraft/cruise missile routes and mission plans using pattern matching neural networks and supervised training.

DESCRIPTION: A proof-of-concept is sought that demonstrates a new method for automating aircraft or cruise missile mission and route planning. The method should be non-algorithmic (e.g., connectionist models/artificial neural networks), and capable of supervised or goal directed learning. The system should operate in three general modes: (1) "basic learning mode" where training can take from hours to days at a shore site; (2) in "fine tuning mode" where the nearly trained system is tuned (in ten minutes or less) to the tactical situation using scenario specific expert rules and constraints based on the latest intelligence/weather, etc.; and, (3) in the "near real-time mode" in which the system, after fine tuning, can produce hundreds of coordinated aircraft/cruise missile strike plans in only a very few minutes.

In the basic learning mode the system should be able to train on very large sets of machine readable data specific to the target area (feature and terrain maps, weather, defense, etc.). Additionally basic learning modes would use standardized data sets (expertly planned route maps) for supervised training.

In the fine tuning mode the system must be able to continue training using a subnet to embed mission specific tactical rules for parallel implementation. These tactical rules may differ from mission to mission and may include such specific items as aircraft or cruise missile type, primary and secondary target designations, time-on-target coordination requirements, etc.

Delivery of a neural network simulation able to solve scaled representations of the problem, e.g. a top problem, is sought for Phase I.

Phase II will develop a hardware/software architecture for solving full scale problems and conclude with a demonstration.

N91-336 TITLE: Automated Aircraft & Cruise Missile Mission and Route Planning Using Parallel Constraint-Satisfaction Techniques

CATEGORY: Exploratory Development

OBJECTIVE: Devise a concept for: (1) near real-time derivation of aircraft/cruise missile route and mission plans using constraint-satisfaction techniques; and, (2) assigning initial values to input parameters in the cost functions.

DESCRIPTION: A proof-of-concept is sought that demonstrates a new method for automating aircraft or cruise missile mission and route planning. The method should emphasize massively parallel processing techniques (algorithmic processing on a shared memory MIMD machine or hierarchical non-algorithmic connectionist models/artificial neural networks). However, a key aspect of this effort, regardless of the method chosen for solving the optimization problem, will be the development of a technique for automatically developing good parameters for the cost functions (e.g., using neural subnets or a parameter set that is positive definite).

The system should operate in two sequential phases: (1) automatic cost function generation - based on generic weapon system constraints (rate of climb, rate of turn, range, etc.) and specific tactical constraints (weather, time-on-target, primary and secondary target types/locations); and, (2) automatic constraint-satisfaction optimization of mission and route plans - based on the number and location of TERCOM maps, feature maps, defense site location, etc.

Delivery of a parallel system able to solve scaled representations of the problem (e.g. a toy problem with 10 cost functions and fewer than 10 stable states) is sought for Phase I.

Phase II: develop a hardware/software architecture for solving full scale problems and conclude with a demonstration.

N91-337 TITLE: Real-Time Image Processing of LADAR Data for Object/Target Classification

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate the integration of a self organizing hierarchical neural network into a connectionist model for image processing and object categorization and classification.

DESCRIPTION: A proof-of-concept is sought that builds upon the Boundary Contour System (BCS), CORT-X and ART-3 work of Carpenter, Grossberg, Mingolla, and Mehanian. Specifically, this is an effort to develop an integrated neural network capable of accepting LADAR returns (from a low flying aircraft or cruise missile sensor ranging stationary or slow moving objects on the ground, and then performing object boundary segmentation, invariant filtering, and pattern classification).

Phase I of this effort will develop an integrated hierarchical neural network similar to ART-3 with an input from a CORT-X like subnet. The effort should demonstrate non real-time classification of various objects based on government furnished LADAR data.

Phase II of this effort will extend the hierarchical network demonstrated in Phase I to near real-time operations and investigate the system as an adjunct to A/I systems for aircraft (Pilot's Advisor) and for use in an advanced cruise missile or reconnaissance vehicle.

N91-338 TITLE: Connectionist Model for Automatic Target Recognition Based on the Theory of "Object Recognition by Components"

CATEGORY: Exploratory Development

OBJECTIVE: Devise a neural network based model for recognition of complex objects.

DESCRIPTION: A proof-of-concept is sought that demonstrates a multi-level connectionist model for automatic recognition of complex military objects based on: the representation of a complex object from a set of primitive objects; information about the relative spatial relationship between primitive objectives that make up the complex object; and, information about the "legitimate" relationships between primitive objects, complex objects, and the scene in a image. The output of this hierarchical connectionist model/neural network must be a Position-Scale-Rotation-Invariant (PSRI) recognition of the complex object and classification (e.g. legitimate SAM site, some component objects of a SAM site, tank, tracked missile launcher, tracked APC, tracked SAM etc.)

Phase I will be a study to demonstrate a multi-level neural network that provides PSRI recognition of a simple geometric primitive and the PSRI identification of a complex object made from the primitives. The purpose of this phase is to demonstrate an orderly transition from an image based frame of reference (assumes low level processing to edges and/or contours) to an object based frame of reference.

Phase II studies will investigate the automatic recognition of complex objects in an object/scene based frame of reference.

N91-339 TITLE: Software Development Process Control

CATEGORY: Advanced Development

OBJECTIVE: Improve the software development process.

DESCRIPTION: An innovative approach is sought for applying statistical process control to a large, complex software development project in a Total Quality Management organization. This project, which may take years to complete and involves many people of diverse scientific disciplines, includes requirements definition, design, code, test, integration, and subsequent maintenance activities. MILSTD 2167 is generally followed. The methodology should include the ability to tract process status and product quality throughout the development cycle to assure management of schedule conformance as well as provide a means for continuously identifying areas for improvement. One approach might be a computer based tracking system for various software metrics that can be easily kept current and that will display trend lines of historical data and flag deviations that might imply schedule or technical risk. Each process phase might have different metrics. The system should be flexible enough to respond to directed requirement and schedule changes throughout the process. Other approaches might work equally well.

N91-340 TITLE: Shipboard Weapon System Crew Training

CATEGORY: Advanced Development

OBJECTIVE: Improve shipboard crew training.

DESCRIPTION: Innovative technologies and methodologies are sought for weapon control system operator training on board ship during routine deployments. No hardware constraints should be assumed. However, it is desired that the training be self paced, and performed without an instructor present. Other characteristics that should be considered are: real-time evaluation of the operator responses, HELP keys, integration with other associated systems, minimal training to use and total realism. Of particular importance is the ability to update the training material when the real system is changed because of maintenance action and upgrades. Bulletins describing workarounds or system anomalies should be easily embedded in the training at the appropriate place.

N91-341 TITLE: Molecular Computing For Automatic Target Recognition

CATEGORY: Research

OBJECTIVE: To construct a prototype computing device from organic materials that demonstrates stability and improved performance over conventional silicon and gallium arsenide based devices.

DESCRIPTION: Organic molecular materials whose functions and operations are controlled by physio-chemical and atomic electronic structure relationships offer a wide range of electronic, magnetic, and optical properties. Examples are optical switching via photoisomerization, signal transduction and transport, pattern recognition, self assembly and repair, and adaptability. Research is sought to understand molecular phenomenon and how to exploit it to design smaller, faster, cheaper and more efficient computing devices. These devices should be applicable to automatic target recognition problems. Innate pattern recognition capabilities of molecular materials, e.g. enzymes, could lead to new computing processes or architectures. These may be implemented in conventional semiconductor materials, bio-molecular materials or in a hybrid system.

Phase I should propose concepts for molecular electronic devices and pattern recognition techniques.

Phase II should conduct research, using the developed concepts, into highly connected and parallel systems for information processing in pattern recognition problems.

N91-342 TITLE: Next Generation of High Power Microwave Source

CATEGORY: Research

OBJECTIVE: Demonstrate a technology capable of generating "unlimited" microwave power.

DESCRIPTION: A large number of high power microwave sources with a fixed single frequency and controllable phase have numerous potential applications such as high-power radars and communication, and electronic defense warfare etc.. Combining groups of oscillators with controllable phase can bring the power up indefinitely to the level unattainable by a single one. A novel approach using magnetron arrays to produce such a unique microwave source is underway at Physics International with little theoretical effort. It is crucial to identify the locking condition and requirement for the phase between two mutually coupled high power relativistic magnetrons. The operation of relativistic magnetrons has been successfully simulated self-consistently by using two-dimensional electromagnetic particle-in-cell codes MASK and MAGIC. The analysis of phase-locking of dual magnetrons can be conducted by means of direct particle simulation of two magnetrons coupled by a transmission line. It is feasible to extend the analysis to the peer coupled case with an arbitrary number of devices. This research has some utility in the design of future experiments relative to the phase-locking of many microwave devices.

N91-343 TITLE: High Power Thermal Batteries for Sonobuoys

CATEGORY: Exploratory Development

OBJECTIVE: Develop a high power thermal battery for use in advanced sonobuoys. The battery must be packaged in as small and economical a package as possible and still produce a ten second, 35 kW pulse. Open circuit voltage should not exceed 350 V, and loaded voltage should not fall below 200 V.

DESCRIPTION: Thermal batteries are increasingly used in a broad spectrum of naval devices. Specifically, they are being considered for use in expendable, high power sonobuoys. While they offer excellent power density, they have not previously been optimized for extremely high power, medium duration single pulses. The technologies needed to attain maximum power density include the development of very thin electrodes and appropriate high conductivity molten salt electrolytes.

N91-344 TITLE: Instrumental Diagnostics for Hypersonic Fluid Mechanics Recognition

CATEGORY: Research

OBJECTIVE: To develop an instrumentation diagnostic to measure temperature and skin friction in the NAVSWC Hypervelocity Tunnel 9.

DESCRIPTION: A need exists for the development of two types of instrumentation diagnostics for the study of hypersonic fluid mechanics, especially in the NAVSWC Hypervelocity Tunnel 9 facility. The first diagnostic is a system which globally and non-intrusively measures the vibrational and rotational static temperature of the wind tunnel flow surrounding a hypersonic test model. The second is a measurement of local wall skin friction. Both diagnostics are paramount in the understanding of the physics of hypersonic flowfields and the validation of computational fluid dynamic codes. Both systems will enhance existing SBIR efforts and can also be extended to other-than-hypersonic fluid mechanic experimental applications.

The temperature measurement diagnostic will enhance the flowfield density measurements obtained from the holographic system currently being developed under SBIR funding. From simultaneous temperature and density measurements, all other flowfield properties will be known. Therefore, an entire flowfield can be mapped and completely understood non-intrusively.

The skin friction diagnostic will determine the wall shear forces which are needed in the understanding of turbulence and model wall properties. Coupled with the current SBIR program which will enhance our IR camera (wall temperature and heat transfer measurements), this diagnostic will allow for the termination of all fluid mechanic surface properties on an aerodynamic model.

Both systems must operate over the following Tunnel 9 environment range:
Mach: 8-14
Test Time: .25 - 5 sec
Freestream: Pressure .001 psia to 14.7 psi
Density .00005 lbm/ft3 to sea level
Temperature 50 DegR to 400 DegR

N91-345 TITLE: Two Color Infrared Processors

CATEGORY: Exploratory Development

OBJECTIVE: Design a feasibility model of a simple, inexpensive signal processor using the NAVSWC developed two color array to detect powered and unpowered air targets in close proximity.

DESCRIPTION: A two color infrared detector array was developed at NAVSWC White Oak by the Solid State Branch. A detector array would be an excellent candidate to detect both powered and unpowered jet aircraft and missiles due to the fact that a two color detection scheme mends itself to better target discrimination. Such a two color scheme would have direct application in proximity fusing for projectiles and missiles. The main objective of the Phase I SBIR is to design the algorithms, using the output of a two color array, to reliably detect a variety of targets in close proximity and then in Phase II to build the signal processor as hard wired electronics and test it to determine its feasibility. The array output will be given to the contract.

In performing the task of designing and building the signal processor, research must first be done to determine the IR characteristics of targets previously described in a variety of environmental scenarios. Likewise, potential weapons on which the two color detector/processor might be used must be identified. For example, such added capability would be a welcomed addition to Navy gun fired projectiles. In order to keep the system simple and inexpensive, it is suggested that the scenario be short range detection, on the order of 100 feet or less, since the eventual objective will be to incorporate the two color system into a fuze and not a seeker, although it has extended possibilities in that area.

In designing and building hardware, special consideration must be given to manufacturability, failure mode analysis, eventual size, and Navy fuze safety requirements. The use of state-of-the-art electronics is suggested in order to keep pace with changing technology and current trends. A microprocessor may be used for initial design, although determining the failure modes of microprocessors is difficult and, therefore, a custom array may be a better choice. Decisions such as these will be made during the course of the research and recommendations will be made with supporting analysis.

NAVAL AIR DEVELOPMENT CENTER

N91-346 TITLE: Multipurpose IR Optical Scanner

CATEGORY: Advanced Development

OBJECTIVE: To develop a multipurpose optical scanner for air ASW and surveillance.

DESCRIPTION: The Navy's infrared imaging equipment provides moderate to high spatial resolution of scenes and targets at 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 systems are needed to provide simultaneously, high spatial resolution of targets and high thermal resolution of the scene. One of the key components needed for such a device is a multipurpose dual function optical scanning 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 and related position sensing and control, collecting optics, and detector interface. 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 (the reconfigurable IR detector assembly is being developed in the FY-91 SBIR Topic No. N91-197), (4) rugged construction for airborne military equipment applications. It is also highly desirable to add a Forward Looking InfraRed (FLIR) scanning mode to the optical system that would allow combining a line scanner and FLIR into a single system. FLIR characteristics should be aimed at a medium to high resolution state of the art device.

The Phase I study would conclude with a design for the optical scanner assembly and associated interfaces 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.

N91-347 TITLE: Long Wavelength Laser Detection System *

CATEGORY: Advanced Development

OBJECTIVE: Develop a low cost Long Wavelength Laser Detection System that will provide a laser intelligence capability to Navy airborne platforms.

DESCRIPTION: Development of effective countermeasures to aircraft and thermal imaging systems being illuminated by long wavelength lasers requires detailed knowledge of the lasers being used. This threat is not clearly defined at this time. A need exists to equip existing infrared imaging systems with a system that can effectively discriminate lasers from non-laser sources and provide a measurement of wavelength, and discriminate pulsed from CW lasers. Measurement of pulse width, PRF, and an estimate of irradiance levels are desired capabilities. The wavelength regions of interest are both the 3-5 micrometer and 8-11 micrometer bands. The system should be capable of resolving the laser wavelength to within 0.5 micrometers. This system would allow correlation of recorded infrared imaging system imagery with the data stored by the laser detection system during an event when the system is directly illuminated that occurs during surveillance operations. The sensing portion of the system must fit within the space available in the existing infrared imaging system turret and on the gimbals, and thus must be suitably small and lightweight. Drawings providing further information concerning the volume available inside the turret are available by contacting the SBIR office. The detector will utilize the present Germanium window used by the infrared imaging system. Data processing, storage, display, and control will be located remotely inside the aircraft. The system is required to detect illumination levels down to 10^{-2} W/cm^2. System Field of View is required to be 20 deg. by 20 deg.

Phase I will require the detailed system design.

Phase II will require the development of a prototype system that can be fully integrated into the infrared imaging system turret.

N91-348 TITLE: Vision Obscuring Device for Simulated Instrument Flight Training

CATEGORY: Engineering Development

OBJECTIVE: To develop a system to allow student naval aviators to fly training flights under simulated instrument meteorological conditions (IMC) from the front cockpit of a T-45 aircraft. This system would be produced for use in the Naval Air Training Command.

DESCRIPTION: Current in-flight IMC training systems use an opaque hood attached to the rear cockpit canopy and glare shield to obscure the student pilot's view of outside cues. An improved system would allow student training in the front cockpit, with the following advantages: (1) student in same cockpit on all flights, (2) cockpit optimization for student/instructor roles (instead of front/rear identical), (3) use of head-up display (located in front cockpit only) as a primary attitude reference instrument, and (4) training for IMC-to-VMC (visual meteorological conditions) transition (obscuration removed, followed by student landing aircraft in VMC). This improved system would use a combination of a helmet visor and canopy/windscreen cover such that each would be relatively transparent, but when used in combination would obscure all outside cues. Previous studies have indicated that a combination of blue/amber or cross-polarized elements might be suitable. The system should be useable in all day and night lighting conditions, acceptable from a human factors standpoint, and compatible with existing aircrew flight equipment and aircraft escape systems.

Phase I should consist of a report documenting an analysis of available and possible systems, and the design concepts proposed for use in the T-45.

Phase II should consist of furnishing the government design documentation and laboratory test results with a prototype suitable and qualified for flight testing.

NAVAL AIR ENGINEERING CENTER

N91-349 TITLE: Embedded Fiber Optic Sensors for Arresting Gear Cables

CATEGORY: Exploratory Development

OBJECTIVE: To investigate the use of embedded fiber optic sensors in arresting gear cables to monitor stress, strain, tension and impact and predict impending failures.

DESCRIPTION: Future arresting gear cable designs will be required to use alternative wire rope and core materials and construction methods to extend loading capacity and service life. Embedded fiber optic sensors have demonstrated the ability to monitor stress, strain and impact of the material that they are embedded in. This reveals the possibility to use embedded fiber optic sensors in arresting gear cable designs to monitor stress, strain, tension and impact as well as predicting, and therefore preventing, impending failures. A cost savings would result because cables would only be replaced when needed as opposed to the current method of replacing cables during regular intervals.

Phase I: Phase I should consist of a study outlining the approach and design methodology which would be used to develop embedded fiber optic sensors that can monitor arresting gear cable conditions in real-time. Phase I should include a survey of optical fiber core, cladding and buffer sizes, types and materials and a conclusion as to which types are best suited for this application. The design methodology should be supported with sufficient data to demonstrate feasibility.

Phase II: Phase II should use the results of Phase I to develop prototype cables with embedded fiber optic sensors for testing and demonstration. The prototypes should demonstrate the ability to monitor stress, strain tension, cable kinks and impact in real-time and be able to predict failures before they occur.

Note: This is not an effort to develop new arresting gear cable materials, it is an investigation into embedded fiber optic sensors that can monitor the health of the cables.

N91-350 TITLE: Personal Computer (PC) Based Eddy Current Probe Characterization and Test Station

CATEGORY: Exploratory Development

OBJECTIVE: To fill the need for a system and equipment to test and characterize performance of eddy current probes.

DESCRIPTION: The eddy current industry is in need of a probe test/characterization station to perform quality assurance and in-service testing of eddy current probes. No system exists to perform standardized quality assurance on eddy current probes. The manufacture and test techniques for these probes is artistic in nature and is different at each manufacturer. Extreme variation exists among probes even when manufactured by the same companies. Recent studies conducted by the Air Force have indicated a seven fold distribution of performance of probes intended to be equal. Standardization of test technique and equipment is needed to improve repeatability of probe performance and improve confidence of inspected aircraft parts.

Phase I: Study and experimentation is required to develop a test and characterization technique using simulated repeatable flaws which will test the probes at all frequencies. The technique needs to consider eddy current repeatable technique and equipment and needs to be useful with portable hardware and produce printed plots and data. The test system needs to be personal computer (PC) based and fully automated.

Phase II: The actual hardware shall be produced as an IBM PC based system in portable form for use and evaluation at Navy activities. The system shall be used on a large number of probes to confirm its ability to find problem probes. The PC itself should not be provided with the system.

NAVAL AIR PROPULSION CENTER

N91-351 TITLE: Advanced Ceramic Cutting Tools for Titanium Alloys

CATEGORY: Advanced Development

OBJECTIVE: To investigate and develop ceramic cutting tools for use on titanium alloys.

DESCRIPTION: Titanium alloys are used extensively in Navy aircraft in both airframe and turbine engine applications. While carbides have been used for machining titanium, they are less then optimum and contain cobalt (a strategic metal) as a binder. The program objective is to reduce dependency on cobalt imports as well as reducing the cost of machining titanium. In the case of machining titanium alloys, the cutting tool behavior is governed by its solubility and reactivity with titanium. The failure mechanism is not a wear type phenomenon.

The work plan should include: 1) powder processing; 2) billet consolidation parameters and evaluation (e.g. density, grain size, and homogeneity; 3) evaluation of hardness, fracture toughness, and interface reactions; 4) fabrication and mechanical properties testing and; 5) documentation of results with assessment of process scale-up.

Phase I: Investigate ceramic exclusive alternatives to carbide cutting tools. The successful completion of the Phase I program will provide a method of consolidation, test data to determine its feasibility as a titanium metal machining tool, and several tool inserts for the Navy to test.

Phase II: Evaluate ceramic cutting tool limiting due to the reactivity and solubility of titanium into the cutting tools.

N91-352 TITLE: Reducing the Toxicity of Beryllium

CATEGORY: Exploratory Development

OBJECTIVE: To reduce effects of beryllium toxicity so that it can be machined and manufactured for use by the military.

DESCRIPTION: Beryllium is currently being used in the aerospace industry to take advantage of its low density, high strength-to-weight and high stiffness-to-weight ratios and excellent thermal conductivity. However, its acceptance and application is limited due to the toxicity of the base alloy and its oxide. Airborne beryllium particles and its salts present a severe health hazard, if inhaled, and parts must be machined in specially equipped facilities. Current exposure levels to beryllium dust are limited to approximately five micrograms per cubic meter. Proposals are requested that address:

a. reducing toxicity of the material itself without reducing the beneficial properties or

b. addressing the processing of finished material.

Phase I should address, identify and carry out any processing techniques (e.g. alloying or changing the size or shape of the beryllium powder) to reduce beryllium toxicity.

Phase II will perform manufacturing of parts in an industrial setting to prove the toxicity reduction to acceptable levels while maintaining the beneficial characteristics of the material.

N91-353 TITLE: Innovative, Lightweight, and Long Life Ignition Concepts for Low Pressure Diesel Engines

CATEGORY: Exploratory Development

OBJECTIVE: To develop a simple, lightweight, and long live ignition system capable of starting and maintaining combustion in low pressure (10:1 CR) diesel engines.

DESCRIPTION: The Navy is developing lightweight diesel engines for use in unmanned aerial vehicles (UAVs) which operate at low compression ratios to minimize weight. For this reason, a source of energy is required in the combustion chamber to assist in starting and maintaining combustion during low power operation and cold conditions. Conventional spark ignitions systems are heavy and short lived under diesel conditions. Standard glow plugs are not capable of sustained operation at full power for long lengths of time. For these reasons the Navy wishes to develop a simple, reliable, lightweight, and innovative ignition system capable of starting and maintaining combustion in low pressure (10:1 CR) diesel engines. The system mean time between failures (MTBF) must exceed 300 engine hours except for components directly exposed to combustion. These components must operate without replacement for a minimum of 50 engine hours.

It is anticipated that investigation into candidate concepts would be divided into two phases. Phase I would generate conceptual designs which would be validated through theory and analytical assessment and/or testing.

Phase II would consist of fabrication of proof of concept designs and experimental verification of the approach.

N91-354 TITLE: Innovative, Lightweight, and Simple Fuel Filtration Concepts for Small Displacement Diesel Engines

CATEGORY: Exploratory Development

OBJECTIVE: To develop a simple lightweight fuel filtration system for use with internal combustion engines designed to operate on a wide range of fuels.

DESCRIPTION: The navy is developing lightweight diesel engines for use in unmanned aerial vehicles (uavs) which operate on a wide variety of heavy fuels (JP-5, JP-8, and diesel). These engines use high speed direct fuel injectors with close internal tolerances which cannot be subjected to any foreign particles in the fuel. For this reason, the navy would like to investigate simple lightweight filtering methods that would produce negligible or no pressure drop across the engine fuel line. The engines have output in the 25 to 100 hp range and have fuel flows in the 0.0 To 70.0 lb/hr Range (at standard conditions). The system must function with fuels operating in the -25f to 125f temperature range.

It is anticipated that investigation into candidate concepts would be divided into two phases. Phase I would generate conceptual designs which would be validated through theory and analytical assessment and/or testing. Based on successful results in Phase I, Phase II would consist of fabrication of proof of concept designs and experimental verification of the approach.

NAVAL AIR TEST CENTER

N91-355 TITLE: Portable Aircraft Flight Test Instrumentation System

CATEGORY: Engineering Development

OBJECTIVE: To develop a portable airborne flying qualities and performance (FQ&P) instrumentation package for remote site aircraft testing.

DESCRIPTION: Flight testing at the Naval Air Test Center (NATC) is usually conducted with highly instrumented aircraft. Certain type tests, like helicopter/ship at-sea Dynamic Interface (DI) testing, are usually conducted at remote sites with un-instrumented fleet helicopters. Without instrumentation only qualitative data can be recorded, which is not adequate for data extrapolation, analysis, or simulation. Portable, light-weight airborne FQ&P data packages, featuring quick and easy installation, calibration and removal, would permit quantitative data to be recorded during DI testing. The instrumentation package should be designed to be compatible with the harsh helicopter vibration environment and aircraft/ship electromagnetic environment. Provisions for mounting the instrumentation package to aircraft support structures should take the airframe crash requirements into account. The package measurements should include aircraft accelerations, rates, attitudes, control positions, power, airspeed, altitude, voice, and time/event correlation, with options for 3-D low airspeed and flight control system actuator positions. Compatibility with ship data packages measuring ship motion and ship airwake parameters is important. Options for miniaturized TM capability to transmit data from aircraft to ship should also be considered.

Phase I: Review existing options (such as MIL-1553 bus, flight control system, multifunction display, etc) for safely accessing flight test parameters in current Navy/Marine Corps rotorcraft. Design a portable airborne instrumentation system for rotorcraft FQ&P or DI testing.

Phase II: Build the portable airborne instrumentation system, in accordance with applicable MIL STDS, and demonstrate installation and calibration in a specified Navy rotorcraft at NATC. Also demonstrate installation in a fleet helicopter and support the instrumentation system during an at-sea DI test. Define any variations in installation required for using the system on other Navy/Marine Corps helicopters.

N91-356 TITLE: Instrumentation System to Measure Ship Motion/Airwake

CATEGORY: Engineering Development

OBJECTIVE: Develop an instrumentation system to measure ship motion and ship airwake to support aircraft/ship testing.

DESCRIPTION: The portable system will be used aboard the ship being tested, and it should be compatible with ship power and ship electromagnetic environment. It should also be light weight and air transportable for remote site aircraft/ship testing. It should be able to record ship speed/direction, ship anemometer readings, ship motion (accelerations, rates, attitudes, displacements), ship airwake data (3-D steady and turbulence at specified locations), voice, time, and video during aircraft/ship tests. It should be possible to perform comprehensive ship airwake/motion surveys using the basic system and airwake measuring sensors on the flight deck, during ship testing without an aircraft. Aircraft/ship tests will typically last 1-2 weeks, with approximately 6 hours of flight testing per day. Large amounts of data processing and data storage capability is required. The instrumentation system software should be user friendly menu-driven, with built-in total system and single channel calibration and checks. The calibrations should account for ship motion at any sensor location with respect to ship center of gravity, center of touchdown spot, or other specified location. Options for presenting real-time aircraft operating limits and for accepting TM data from the aircraft should be considered.

Phase I: Review existing instrumentation systems and sensors used for measuring ship motion and ship airwake. Also review both rotary wing and fixed wing aircraft/ship test instrumentation requirements. Develop a preliminary instrumentation system design. Also identify required airwake sensors to support airwake measurements.

Phase II: Complete the instrumentation system design. Build the instrumentation system, in accordance with applicable MIL STDS, and acquire airwake measuring sensors. Demonstrate system operation and check-out at the Naval Air Test Center (NATC). Also demonstrate system operation and check-out during an NATC helicopter/ship at-sea Dynamic Interface (DI) test. Provide complete documentation and user instructions for the ship instrumentation system and associated sensors.

NAVAL TRAINING SYSTEMS CENTER

N91-357 TITLE: Knowledge-Based Intelligent Tutoring System (ITS) Development Tool for Tabletop Training Systems

CATEGORY: Engineering Development

OBJECTIVE: To design and develop a low-cost, intelligent, tabletop trainer development system. The system would enable rapid prototyping of ITSs.

DESCRIPTION: Intelligent Tutoring Systems (ITSs) typically take a significant amount of time and resources to develop. Some of the components, such as those that manage the training session and student performance, could be predefined so that ITS development would take less effort. The tool itself should be based on expert system technology both for control over the development environment and for final ITS execution. Given such an ITS development tool on a low-cost, tabletop computer

system, the course writer need only concentrate efforts on the specifics of the information to be learned by the student. As a result, development of tabletop trainers would require significantly fewer resources, enabling greater deployment of the technology.

Phase I: The offeror will perform a preliminary concept design with conformance to the specifications stated above. The offeror will also show ability to construct a prototype of said device.

Phase II: The offeror will finalize display design and construct a prototype.

N91-358 TITLE: Gas Mask Sensor to Detect Whether Mask is Fully Sealed

CATEGORY: Advanced Development

OBJECTIVE: Develop a detection device for use with a gas mask to determine if the mask is fully sealed. The device is to be used in training exercises to enhance performance of the mask donning task and provide objective feedback.

DESCRIPTION: The Desert Shield mission may expose Navy personnel to chemical attacks. The ability of personnel to don the gas mask quickly and effectively is basic to survival in a chemical environment. Although the protective mask is the single most crucial article of chemical defense equipment, there is no current training-effective shipboard method for mask donning drill. Mask training currently takes place during Recruit Training. The training consists of entering a tear gas chamber while wearing the sealed mask, breathing through the filter a few times, and then removing the mask so that the contrast with the protected state is appreciated. This method of training is not feasible for a shipboard environment. Also, research has indicated that the tear gas chamber exercise sometimes decreases confidence rather than promoting it. This occurs because many students are unable to completely seal their masks, but they do not report their failure for fear of having to repeat the exercise. Use of a sensor to indicate whether or not the mask is fully sealed would provide objective feedback to the mask wearer as well as to the instructor. The immediate and objective feedback provided will greatly potentiate the mask donning practice.

Phase I: The first phase will consist of identifying technologies for providing a mask sensor, and performing trade-off analyses to determine the most cost-effective method of implementation.

Phase II: In the second phase a mask sensor will be developed and experiments will be conducted with the gas mask to determine the training effectiveness of the device as a source of performance feedback.

NAVAL WEAPONS CENTER

N91-359 TITLE: Develop an Integrated Missile Power Supply and Roll Control System

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this work is to develop an integrated electric power supply and roll attitude control system for a tactical missile. Innovative methods are sought to improve on the state of the art with power storage and/or generation technology that includes capability to generate missile roll damping forces. Such technology would improve on the use of missile volume by combining weapon power and roll attitude control into one package. This technology would apply to a movable nozzle-based thrust vector controlled missile or generic missile in which no inherit roll control is available. New technology or an innovative integration of existing techniques are sought that could apply to tactical air-launched missiles.

DESCRIPTION: An example approach envisioned for this research would be a suitable integration of an inertial energy storage system to provide an electric power generator and a bi-directional roll torque generator. Features such as minimum weight, low volume, low cost, long shelf-life, reliability, and a short mission duration are desirable. Target criteria (listed below) will be used as benchmarks to assess the degree of improvement over current technology:
Maximum Envelope: Cylinder (seven inch max diameter, five inch max length)
Minimum Specific Energy: 10 Kilo-Joules/pound
Minimum Energy Density: 1.2 Kilo-Joules/cubic inch
Minimum Delivered Energy: 210 Kilo-Joules
Maximum Weight: 21 pounds
Power Generation Benchmarks: Bi-directional torque production:
Maximum Startup time 60 Sec
Maximum roll torque 200 inch-pounds
Minimum operating life 60 Sec
Minimum delivered Voltage 100 Volts
Minimum Peak Power Drain 18.2 Kw
Minimum Continuous Power 3.5 Kw

The roll torque production rate and duration is constrained by the total energy dedicated to roll control. The benchmark for total production is a minimum of 30% of the deliverable energy. The benchmark minimum torque production rate is that which can be achieved from a peak instantaneous energy use of 18.2 Kw.

Phase I would include a study of feasibility, a technology assessment and selection, a definition of approach and the process used to achieve expected results, and a prediction of expected performance.

Phase II should follow the approach outlined in Phase I to design, fabricate, test, and assess the performance of a prototype device. A prototype will also be delivered to the government for testing.

N91-360 TITLE: Multi-resolution Wavelet Image Tracking

CATEGORY: Exploratory Development

OBJECTIVE: This research will explore the uniqueness of multiresolution, shock filters, wavelet transforms and other new algorithms to characterize artificial and natural features at scales, to separate noise from texture and then combine these in the development of tracking or accurate target localization algorithms.

DESCRIPTION: Infrared or electro-optical imaging systems are prime examples of new sensor systems that produce vast amounts of data that greatly increase the computational burden while processing a particular image or image sequences. Target tracking and image identification from image sequences is traditionally achieved by optical flow computations or by linear template matching (e.g., matched filters). However, these are not always reliable in the presence of significant noise, blurring, and other quantities such as texture, occlusions, and dynamic changes. Multiresolution wavelet transforms, shock capturing filters, essentially nonocillatory deconvolutions are examples of new algorithms that can separate texture from noise, restore image degradations and extract local information about "targets". To realize the potential that these unique and innovative fast image processing tools offer, their compatibility with imaging technologies must be tested.

Phase I: Phase I will be a study to determine the algorithms ability for target localization in a variety of scenes and patterns.

Phase II: Phase II will combine the promising algorithms found in Phase II to produce new techniques to extract image information for evaluation in real-time target tracking algorithms.

N91-361 TITLE: High Voltage/High Density Capacitor

CATEGORY: Advanced Development

OBJECTIVE: The objective of this task is to develop a high energy, high density capacitor for use with LASER initiation systems.

DESCRIPTION: Currently available capacitors are too large to be practical for use with LASER initiation systems in tactical guided missiles due to space allocations for Ordnance components. High energy density capacitors are needed to make LASER initiation systems practical for use in firing rocket motors and warhead explosive trains. The requirements for the capacitor are:

a) Capacitance = 20 uF +/- 10%(Design Goal) over the temperature range of -65 to + 165 degrees F.
b) Breakdown voltage shall be 2.2kV minimum over the temperature range.specified above.
c) Working voltage shall be 2.0 kV WVDC minimum.
d) The desired geometry of the capacitor is a cylinder 1 inch in diameter by 1.2 long, however; other configurations of equivalent volume may be acceptable.
e) ESR shall be 400 milliohms maximum in the frequency range of 120 Hz to 40 kHz over the temperature range specified above.

N91-362 TITLE: Replacement Explosive for HNS-IV (HEXANITROSTILBANE)

CATEGORY: Advanced Development

OBJECTIVE: The objective of this task is to find a replacement explosive for HNS-IV which is the explosive used in Exploding Foil Initiators (EFIs). The EFI is sometimes referred to as the "Slapper" detonator and is used as the primary initiator in Safety-Arming devices that feature a non-interrupted explosive train.

DESCRIPTION: HNS-IV is expensive, difficult to produce, only one source is a qualified to produce the explosive for government use, and it is difficult to press and load. Alternate explosives must be formulated before the EFI can be considered a viable candidate for Department of Defense applications. The requirements for the explosive, in general terms, are:

a) A secondary or booster explosive, as defined in paragraph 4.3.1 of MIL-STD-1316C, must be used.
b) The energy required to initiate the explosive with an EFI shall be equal to or less than HNS-IV.
c) The explosive shall retain its characteristics over the temperature range of -55 to +165 degrees F.
d) The explosive must be capable of being loaded into detonators by means of pressing or by hot melt techniques.

N91-363 TITLE: Low Cost Magnetic Heading Reference

CATEGORY: Advanced Development

OBJECTIVE: To determine the feasibility in packaging and using the very low cost Hall Effect transducer in an orientation invariant magnetic compass for midcourse guidance applications.

DESCRIPTION: Breadboard hardware for a low cost magnetic compass with output accuracy of better than one-half degree of magnetic north has been demonstrated throughout three degree of freedom rotation. The breadboard was implemented with a very low cost Hall Effect transducer as a replacement for high cost flux gate compass. A closed loop flux nulling technique was used to linearize the output and greatly reduce transducer errors. Current reversal signal processing of the Hall transducer output also greatly reduces the temperature error effect normally associated with Hall transducer. Accuracy of the overall closed loop system is primarily determined by two stable passive components, a coil and a resistor. Design disclosure will be provided by the government.

PHASE I: Phase I would be a study to optimize the design to demonstrate the producibility of the low cost, Hall Effect transducer based, magnetic heading reference with the above demonstrated accuracy. Sufficient analytical data shall be provided to demonstrate feasibility and make well grounded selections in design and packaging technology.

PHASE II: Phase II shall use the approved design packaging technology from Phase I to produce two magnetic heading reference systems using the above Hall Effect Transducer design disclosure.

N91-364 TITLE: Low Cost Multi-Spectral Sub-Sonic Radome

CATEGORY: Advanced Development

OBJECTIVE: To determine the feasibility of the manufacturing of a low cost, sub-sonic, optical quality, multi-spectral radome compatible with acceptable receipt of both visual light and radio frequencies. The radio frequencies will be from 2-18 GHz and received on a 4-arm spiral antenna.

DESCRIPTION: The enemy air defense threat to Navy air strike warfare forces has increased both in quality and quantity and include countermeasures that effectively neutralize radio frequency only sensors. The development of a low cost multi-spectral (EO/RF) sensor is being investigated and a low cost multi-spectral radome for sub-sonic vehicles would greatly enhance the successful completion of this effort.

PHASE I: Phase I would be a study examining different materials and fabrication techniques to meet the above requirements of a sub-sonic multi-spectral radome. Sufficient analytical data shall be provided to demonstrate feasibility and make well grounded selections of materials and fabrication techniques.

PHASE II: Phase II shall use the approved material and fabrication techniques from Phase I to produce three multi-spectral radomes and deliver them to the government for testing.

N91-365 TITLE: Electronic Nutation Damping of Free Gyro Seekers

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of IR Seekers.

DESCRIPTION: Free gyro seekers like the Sidewinder have traditionally used complex mechanical dampers to reduce the oscillation of the seeker at the nutation frequency of the gyro. These mechanical designs are inherently j frequency dependent. Current designs can be improved if the gyro speed is higher and variable. This requires that the nutation damping be adjustable. Electronic damping may be possible over a range of gyro speeds. The objective of this initiative is to design and demonstrate electronic damping of a small free gyro for application to an IR seeker. The design parameters for the Multispectrum Guidance

seeker will be provided for the initial design.

It is anticipated that this topic will require access to classified information upon awarding a Phase II contract. Interested applicants must posses or have the capability to obtain facility/personnel clearance up to and including the level of SECRET. The Naval Weapons Center SBIR Office can provide information on the Multispectrum Guidance Project.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to design and demonstrate electronic damping of a small free gyro for application to an IR seeker.

N91-366 TITLE: Optimized Antennas for Multispectrum Guidance

CATEGORY: Exploratory Development

OBJECTIVE: Improve system performance of RF seekers with aperture blockage.

DESCRIPTION: Multispectrum seeker systems are being developed which will include a coaxial IR system mounted in the radome of a gimballed RF seeker. Presently the RF and IR seekers are developed independently and integrated into a single system. The RF antenna patterns are degraded by the presence of the IR blockage. Total system performance could be improved by designing the RF antenna for optimum average performance over all RF gimbal angles in the presence of IR seeker blockage. The objective of this initiative is the development and test of an optimized RF antenna in the presence of the IR seeker blockage. The degradation in antenna gain and sidelobes will be minimized as well as the magnitude of the boresight errors caused by the IR blockage.

It is anticipated that this topic will require access to classified information upon awarding a Phase II contract. Interested applicants must possess or have the capability to obtain facility/personnel clearance up to and including the level of SECRET. The Naval Weapons Center SBIR Office can provide information on the Multispectrum Guidance Project.

Phase I: Study outlining the approach which will be undertaken to pursue requirements addressed above with sufficient data to demonstrate feasibility.

Phase II: Use the approach outlined in Phase I to design and demonstrate the ability to apply the optimization techniques to the antenna used on the Multispectrum Guidance Project.

PACIFIC MISSILE TEST CENTER

N91-367 TITLE: Application of Mission Support Systems Technology to Navy Fighters

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate ground-based mission planning and software parameter tailoring for Navy fighter avionics software.

DESCRIPTION: Mission planning and mission support systems that have evolved to support Navy and Air Force Tactical Aircraft (TACAIR) have focused on characterizing the ground-based threat and scenario environments associated with air-to-ground attack by manned aircraft or cruise missiles. Further, the Navy's designated core mission planning system for future use by all of TACAIR, the Tactical Aircraft Mission Planning System (TAMPS), was developed for stand alone mission planning and not the avionics/weapons employment missionization and subsequent mission loading to onboard aircraft systems. Additionally, Navy fighters have not had the type of complex, software intensive systems and weapons that could be supported by a mission planning and support system until the arrival of the dual role F/A-18, the F-14D, and the future Navy Advanced Tactical Fighter (NATF). These circumstances have left a void in mission planning research and development initiatives for the Navy fighter community. Adequate support resources do not exist to help aircrew fully utilize the capabilities of their weapon systems in air-to-air combat. Advanced, complex weapon systems require mission support systems to achieve optimum system employment at the direction of aircrew while reducing their workload saturation problems. This effort is designed to provide proof of the unique mission support concept for fighters, demonstrate the mission tailoring of existing Navy fighter avionics software parameters, serve as a first step for the development of an advanced fighter mission planning module to interface with TAMPS, and demonstrate risk reduction for a key function of the NATF program.

Phase I - Research existing tactical air mission support technology and determine the hardware, software and interface requirements necessary to plan air-to-air tactics for the current and next generation Navy fighter aircraft and subsequently load/program those tailorable software parameters in the aircraft.

Phase II - Develop prototype hardware, software and interface to demonstrate air-to-air combat tactics planning and programming of Navy fighter avionics consistent with typical mission plans.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Submission of Proposals

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

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

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

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

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

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

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

DARPA 1991 Phase I SBIR

Check List

1) Proposal Format

a.	Cover Sheet - Apendix 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 Development	____
h.	Post Potential Applications	____
i.	Key Personnel	____
j.	Facilities/Equipment	____
k.	Consultants	____
l.	Prior, Current or Pending Support	____
m.	Cost Proposal	____

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 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

a.	For DARPA you must submit 4 copies plus the original signature **RED** copy (total 5) for each proposal to be considered.	____
b.	In addition you must submit two copies of Appendix A and Appendix B only, for each proposal submission.	____

SUBJECT/WORD INDEX TO THE DARPA FY91 SBIR PHASE I TOPICS

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

FY 1991 Small Business Innovation Research Topics

DARPA 91-084 Technologies for Visualization of Complex Technical Processes and Novel Approaches for Presenting/Displaying Such Information

DARPA 91-085 Multispectral Data Analysis Techniques on Commercial Satellite Imagery for Arms Control Monitoring

DARPA 91-086 Automated Seismic Analysis Using Supervised Machine Learning

DARPA 91-087 Electromagnetic Methods for Determining the Size of Underground Nuclear Explosions Based on Signals Recorded within a Few Kilometers

DARPA 91-088 Designs for Miniaturized, Ruggedized, Low-cost Seismic Stations Incorporating Automated Signal Processing for Deployment in Third World Environments

DARPA 91-089 Identification of Technical Capability Needed to Monitor Foreign Nuclear Weapons Development for Nonproliferation Monitoring

DARPA 91-090 Collecting and Interpreting Hydrodynamic Shock Wave Data from Low Yield Nuclear Explosions

DARPA 91-091 Yield Estimation Methodologies Using Data Collected from Soviet Seismic Networks

DARPA 91-092 Advanced Statistical Methods to Interpret Seismic Yield Estimates of Soviet Nuclear Explosions

DARPA 91-093 Ceramic Fiber Development

DARPA 91-094 Smart Materials and Structures

DARPA 91-095 Sensors for Intelligent Processing of Materials

DARPA 91-096 Ceramic Bearing Research

DARPA 91-097 Halogen Assisted Diamond Deposition

DARPA 91-098 Application of High Temperature Superconductors to Electronic Circuitry

DARPA 91-099 Ceramic Shields for Satellite Protection Against Hypervelocity Impact

DARPA 91-100 Supercritical Fluid Processing Technology

DARPA 91-101 Novel Solid Electrolytes for Batteries

DARPA 91-102 Alternative Methods for Chemical/Biological Weapons Agent Demilitarization

DARPA 91-103 Supercritical Fluid Processing Routes to High Modulus Thermoplastic Composites

DARPA 91-104 Structural Ceramics Enabling Demonstration

DARPA 91-105 Compressive Surface Strengthening of Pressure Densified Structural Ceramics

DARPA 91-106 Applications of Gabor Bases to Extract Information from the Wigner/Ville Transform

DARPA 91-107 Using Neutral Networks in Intelligent Control of Manufacturing Processes

DARPA 91-108 Ferroelectric Materials for Longwave Staring Infrared Focal Plane Array Multiplexer Storage Capacitors

DARPA 91-109 Biological Signal Processing

DARPA 91-110 Biomimetic Design

DARPA 91-111 Environmental Science

DARPA 91-112 193 nm Excimer Laser Development for Lithography

DARPA 91-113 Neural Networks Applied to Control or Diagnostic Tasks

DARPA 91-114 Advanced Analog to Digital Convertor Design Studies for Wide Dynamic Range, Gigasample Conversion Rate, Monolithic Chip Architectures

DARPA 91-115 Efficient Slab Lasers

DARPA 91-116 High-speed Electro-optic Modulators

DARPA 91-117 Microlasers

DARPA 91-118 Tunable Coherent Infrared Radiation Source at 3-5 Microns

DARPA 91-119 Innovative Applications of Electron Beam Welding

DARPA 91-120 Vacuum Microelectronics Development

DARPA 91-121 Corrosion Monitor for Supercritical Water Oxidation

DARPA 91-122 Contribution/Control of Polymer Reaction in Responsive Armor

DARPA 91-123 Novel Penetrator Defeat Mechanisms for Light Armor Vehicles

DARPA 91-124 Unique/Novel Lightweight Applique Armor Attachment Technologies

DARPA 91-125 Metallic Composite Armor for Light and/or Ultralight Applications

DARPA 91-126 Novel Ceramic Processing Techniques

DARPA 91-127 Fracture, Erosion and Failure Models for Armor/Antiarmor Hydrocodes

DARPA 91-128 High Power Flat Panel Light Sources for Visible Signature Control

DARPA 91-129 Optical Window Materials/Systems with High Visual and Infrared Transmissivity and High Electrical Conductivity

DARPA 91-130 Low-cost Optically Transparent Materials with High Thermal Conductivity

DARPA 91-131 High Payoff Mine/Barrier Concepts

DARPA 91-132 Methods to Attack Target Vehicles by Reducing or Eliminating Effectiveness of Firepower, Mobility, Communications, and/or Rendering Targets Vulnerable to Further Attack

DARPA 91-133 Individual Soldier Protective Ensemble Cooling

DARPA 91-134 Flexible, Deformable Surfaces Formed from Arrays of Submillimeter Sized, Linear Electromechanical Actuators

DARPA 91-135 Acoustic Sensors for Automatic Target Recognition of Ground Vehicles

DARPA 91-136 Integrated Fiber Optics/Photonics Systems for Netted Sensor Systems

DARPA 91-137 Fiber Optic Radio Frequency Transducers for Remote Reception of Electromagnetic Energy

DARPA 91-138 Applications of Acoustic Charge Transport Signal Microprocessor Technology

DARPA 91-139 Fiber Optic Transducer and Network Systems for Distributed Large Area Advanced Over the Horizon & High Frequency Receiving Systems

DARPA 91-140 Modular Architecture for Computer Image Generation

DARPA 91-141 Table-top, Distributed Simulation of Logistics in Battlefield Simulations

DARPA 91-142 Workstation for Parametric Analysis of Weapons/Weapons Systems in Distributed Simulation

DARPA 91-143 Adaptive Digital Array Processing for Clutter and Jammer Suppression in Spatially and Temporally Variant Environments

DARPA 91-144 Detection and Targeting Electro-optic/Infrared Imaging Sensors/Processing for Ground Targets with Suppressed Signatures

DARPA 91-145 Detection and Targeting Sensors for Ground Targets with Low Radar Cross Sections

DARPA 91-146 Application of Vitreous Materials

DARPA 91-147 Develop Numerical Approaches to Accurately Predict and Model Behind Armor Effects for Chemical Energy or Kinetic Energy Armor Penetrating Projectiles

DARPA 91-148 Nonlinear Detection of Weak Signals in Clutter

DARPA 91-149 Investigation of Metallurgical and Processing Effects of Implementing New Alloys for Shaped Charge Liners

DARPA 91-150 Optimizing Layer Thickness in Laminated Armors

DARPA 91-151 Aggregate Software

DARPA 91-152 Effectiveness of Metal Backplates on Ceramic Armor

DARPA 91-153 Novel Antiarmor Projectile Defeat Mechanisms

DARPA 91-154 Hybrid Composites for Ultralight Armors

DARPA 91-155 Innovative Packaging Techniques and Package Models

DARPA 91-156 Computer Aided Design and Process Models for Microwave and Millimeter Wave Devices and Circuits

DARPA 91-157 Advanced Testing Techniques for Millimeter Wave Monolithic Integrated Circuits

DARPA 91-158 Computer-based Display Design Tool

DARPA 91-159 High Temperature Polarizing Materials

DARPA 91-160 Color Filter Materials

DARPA 91-161 Lamps for Use as Display Backlight Sources

DARPA 91-162 Light Sources for Projection Display Systems

DARPA 91-163 Equipment for Testing Liquid Crystal Active Matrix Display Panels

DARPA 91-164 Automatic Repair Equipment

DARPA 91-165 Antifuse Process Technology

DARPA 91-166 Modeling of Process Control Sensor Requirements for Electronics and Opto-electronics Manufacturing

DARPA 91-167 Signal Processing for the Sensor-based Control of Electronic and Opto-electronics Manufacturing

DARPA 91-168 Process Control Sensor Development and Demonstration for Electronic and Opto-electronics Manufacturing

DARPA 91-169 Low-cost Cryogenic Packaging for Infrared Focal Plane Arrays

DARPA 91-170 Multiple Sensors to Control Chemical Deposition Processes and Plasma Etching of Compound Semiconductors

DARPA 91-171 On-chip Processing for Imaging Sensors

DARPA 91-172 High Speed Sensing Techniques to Determine the Surface Profiles of Materials and Components for Electronic Packaging

DARPA 91-173 In-situ Sensing and Control of High Temperature Manufacturing Processes

DARPA 91-174 Nondestructive Material Evaluation to Determine Structural Defects and Predict Reliability

DARPA 91-175 Designs and Concepts for High Performance, Uncooled Infrared Imaging Sensors

DARPA 91-176 Designs for Multi-spectral Infrared Imaging Systems

DARPA 91-177 Infrared Focal Plane Design, with On-focal Plane Signal Processing, for Multiple System Applications

DARPA 91-178 Virtual Prototyping Tools for Semiconductor Fabrication Equipment

DARPA 91-179 Embedded Control Software for Semiconductor Process Equipment

DARPA 91-180 Novel Computer Aided Design Tools for Hybrid Systems

DARPA 91-181 Modeling, Simulation, and Control of Semiconductor Factories

DARPA 91-182 Integrated Technology Computer Aided Design

DARPA 91-183 Application Software

DARPA 91-184 Small Vocabulary Tactical Speech Recognizer

DARPA 91-185 Semantic Search of Information Databases

DARPA 91-186 Reusable Knowledge Bases of Engineering Designs Based on a Standard Ontology

DARPA 91-187 Reusable Knowledge Bases

DARPA 91-188 Use of Object Oriented Databases to Support Knowledge-based Planning

DARPA 91-189 Model Interface Conventions for Logistics

DARPA 91-190 Standard Machine Learning Modules

DARPA 91-191 Technology for All-optical Networks

DARPA 91-192 Personal Multi-media Conferencing

DARPA 91-193 Interface Technology for Switched Multimegabit Data Service

DARPA 91-194 Technology for Asynchronous Tranfser Module-based Internetworking

DARPA 91-195 Interoperable Design Tools Supporting Acquisition Technology Infrastructure

DARPA 91-196 System Level Modeling Tools and Methodologies that Execute in Multiple Simulation Environments

DARPA 91-197 Rapid Prototyping Techniques that Augment Existing Design Systems

DARPA 91-198 Interoperable Technology Computer-aided Design (CAD) Tools for Electronic CAD

DARPA 91-199 High Performance, Low-cost, Multi-chip Module Design Aids that Support Multiple Technologies

DARPA 91-200 Technology Independent, High Performance Design Tools

DARPA 91-201 Object Oriented Database Implementations Consistent with Emerging ANSI X3/SPARC/OODBTG Open Architecture Interface Standards

DARPA 91-202 Object Oriented Image Libraries of Worldwide Military Hardware and Civilian Vehicles for Recognition and Evaluation of Image Understanding Algorithms

DARPA 91-203 Laboratory Grade Robotic Research Vehicle with Sensor Package and Processing Capabilities Compatible with DoD JUGVMPO Surrogate Semiautonomous Vehicle

DARPA 91-204 Connector Technologies

DARPA 91-205 Memory System

DARPA 91-206 Very Large Scale Integration Cell Library

DARPA 91-207 Compiler Controlled Power

DARPA 91-208 Software Tools which Translate Software from Other Languages to Ada

DARPA 91-209 Software Tools which Re-engineer Poor Ada Systems into Optimized Ones

DARPA 91-210 Domain Specific Software Architecture Ada Reusable Software Assets

DARPA 91-211 Domain Specific Software Process Automation Technology

DARPA 91-212 Software Asset Repository Technology and Composition Tools

DARPA 91-213 Software Tools for Domain Specific Analysis

DARPA 91-214 Software Tools to Improve the Interaction Between the Buyers and Suppliers of Non-off-the-shelf Software

DARPA 91-215 Design and Construction of Image Content-addressable Databases

DARPA 91-216 Evaluation Methods and Metrics for Image Processing and Understanding Algorithms

DARPA 91-217 Standard Model-based Reasoning Modules

DARPA 91-218 Standard Decision Analysis Modules for Knowledge-based Planning Support

DARPA 91-219 User Tailorable Models for Logistics

DARPA 91-220 Replacement Materials for Chlorofluorocarbons

DARPA 91-221 Replacement Materials for Halon Fire Extinguishers

DARPA 91-222 Simulation of High Strain Rates for Optical Fiber

DARPA 91-223 Expert System for Computer Aided Process Planning

DARPA 91-224 High Density Connector Technology for Miniaturized Electronic Assemblies

DARPA 91-225 Transmission of 25 Watts of Gallium Arsenide Diode Laser Power Down a Fiber Optic

DARPA 91-226 System for Locating Tank Mounted Guns

DARPA 91-227 Development of a Compact Hardened Dye Laser

DARPA 91-228 Spatial Light Modulator Utilizing Deformable Mirror Devices for Infrared Projection for Hardware-in-the-loop Simulation Applications

DARPA 91-229 Infrared Signal Combining Techniques for Multicolor Projector Applications

DARPA 91-230 Infrared Laser Diode Based Infrared Projector

DARPA 91-231 Ultra Low Cost Fuel Control System for Expendable Turbojet Engines

DARPA 91-232 Technologies for Intensifying High Density Charge Coupled Device Detectors

DARPA 91-233 Technologies for Obtaining a Real-time Readoff Rates for High Density Charge Coupled Device Detectors

DARPA 91-234 Small, Low-cost Fiber Optic and Discrete Sensors for Remote Sensing of Temperature, Smoke, Flame and Concentrations/Partial Pressures of Organic and Nonorganic Materials

DARPA 91-235 Innovative Electro-optical Sensor Development to Detect From Airborne Platforms, Small Scale Vertical Airmass Movements and Velocity Gradients in Clear Air

DARPA 91-236 Low-cost, Man-portable Real-time Weather Satellite Data Receiving, Processing and Display Technology

DARPA 91-237 Low-cost, Miniature Tactical Jammers

DARPA 91-238 Light-weight, High Efficiency, Space Qualified, Flexible Solar Array Technology

DARPA 91-239 High Energy-density Fuel and Oxidant Storage for Fuel Cell Systems Suitable for Undersea Vehicle Applications

DARPA 91-240 Airborne Sensors for the Detection of Clear Air Turbulence from Sea Level to 100,000 Feet

DARPA 91-241 Low Cost, Low Weight Icing Detectors and Anti-icing Devices for Unmanned Autonomous Vehicles

DARPA 91-242 Low Cost, Portable Automatic Landing System for Unmanned Autonomous Vehicles

DARPA 91-243 Manufacturing Methods for Low Cost, High Quality Unmanned Autonomous Vehicle Airframes

DARPA 91-084 TITLE: Technologies for Visualization of Complex Technical Processes and Novel Approaches for Presenting/Displaying Such Information

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-085 TITLE: Multispectral Data Analysis Techniques on Commercial Satellite Imagery for Arms Control Monitoring

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-086 TITLE: Automated Seismic Analysis Using Supervised Machine Learning

CATEGORY: Exploratory Development

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

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

domain experts) to effect a steady and controlled increase in the cognitive capability of the IMS to automatically analyze seismic data.

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

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

DARPA 91-087 TITLE: Electromagnetic Methods for Determining the Size of Underground Nuclear Explosions Based on Signals Recorded within a Few Kilometers

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-088 TITLE: Designs for Miniaturized, Ruggedized, Low-cost Seismic Stations Incorporating Automated Signal Processing for Deployment in Third World Environments

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-089 TITLE: Identification of Technical Capability Needed to Monitor Foreign Weapons Development for Nonproliferation Monitoring

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-090 TITLE: Collecting and Interpreting Hydrodynamic Shock Wave Data from Low Yield Nuclear Explosions

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-091 TITLE: Yield Estimation Methodologies Using Data Collected from Soviet Seismic Networks

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-092 TITLE: Advanced Statistical Methods to Interpret Seismic Yield Estimates of Soviet Nuclear Explosions

CATEGORY: Basic Research

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

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

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

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

DARPA 91-093 TITLE: Ceramic Fiber Development

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-094 TITLE: Smart Materials and Structures

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-095 TITLE: Sensors for Intelligent Processing of Materials

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-096 TITLE: Ceramic Bearings Research

CATEGORY: Basic Research

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

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

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

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

DARPA 91-097 TITLE: Halogen Assisted Diamond Deposition

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-098 TITLE: Application of High Temperature Superconductors to Electronic Circuitry

CATEGORY: Advanced Development

OBJECTIVE: Determine how high temperature (nominally 80°K) superconductor materials can be introduced into electronic circuitry to enhance overall properties of signal dispersion, frequency response, packing density, reduced crosstalk and reduced power dissipation.

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

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

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

DARPA 91-099 Title: Ceramic Shields for Satellite Protection Against Hypervelocity Impact

CATEGORY: Basic Research

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

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

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

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

DARPA 91-100 TITLE: Supercritical Fluid Processing Technology

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-101 TITLE: Novel Solid Electrolytes for Batteries

CATEGORY: Exploratory Development

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

DESCRIPTION: The DARPA Electrochemical Power Sources Program is investigating the production of a rechargeable, high energy/power density, all solid state battery, based on the lithium/polymer electrolyte/insertion cathode concept. Novel electrolytes are sought which might lead to an increase in the already significant room temperature ionic conductivities ($> 10^{-3}$ S/cm) achieved. High ionic conductivity over a broad (low) temperature range, chemical compatibility, processibility, and electrochemical stability are all important considerations. Approaches that integrate a fundamental understanding of ion mobility in solid electrolytes with the design, fabrication, and evaluation of these materials will receive serious consideration.

Phase I: Develop and test promising candidate solid electrolytes.

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

DARPA 91-102 TITLE: Alternative Methods for Chemical/Biological Weapons Agent Demilitarization

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-103 TITLE: Supercritical Fluid Processing Routes to High Modules Thermoplastic Composites

CATEGORY: Basic Research

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

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

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

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

DARPA 91-104 TITLE: Structural Ceramics Enabling Demonstration

CATEGORY: Advanced Development

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

DESCRIPTION: Ceramics offer advantages in strength, elastic modules, wear and corrosion resistance, reduced weight, durability in extreme environments, and in elevated temperature use. Thus the application of ceramics in certain military systems offers potential improvements in the performance of these systems. The proposal should identify cost-effective ways to significantly increase the capabilities of DoD systems through the infusion of advanced state-of-the-art structural ceramics into fielded weapon systems or platforms. The demonstration should use commercially available materials in any application with military utility. A design methodology appropriate to ceramics must be employed.

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

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

DARPA 91-105 TITLE: Compressive Surface Strengthening of Pressure Densified Structural Ceramics

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-106 TITLE: Applications of Gabor Bases to Extracting Information from the Wigner/Ville Transform

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-107 TITLE: Using Neural Networks in Intelligent Control of Manufacturing Processes

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-108 TITLE: Ferroelectric Materials for Longwave Staring Infrared Focal Plane Array Multiplexer Storage Capacitors

CATEGORY: Basic Research

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

DESCRIPTION: The inability to store total photogenerated charge is currently a limiting factor in the performance of longwave (8-12 micron) IRFPAs. For a 1 mil cell, silicon charge coupled devices can hold about 1 X 10^5 electrons, and complementary metal oxide semiconductor integrating capacitors can store approximately 1 X 10^7 electrons. In practice, the photogenerated flux is attenuated (e.g., filtering, gain reduction, low quantum efficiency detectors, etc.) before storage, thus throwing away valuable signal and effectively degrading noise equivalent temperature difference. Signal/noise ratio could be significantly improved if high dielectric constant integrating capacitors were integrated into the IRFPA readout electronics.

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

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

DARPA 91-109 TITLE: Biological Signal Processing

CATEGORY: Exploratory Development

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

DESCRIPTION: Evolutionary pressures impacting living organisms have led to the development of extraordinary sensory and perceptual systems insuring success in diverse (i.e. air, land, sea) environments. We currently know a great deal about living organisms novel sensory mechanisms (e.g., photoreceptors, acoustic detectors) and are starting to make significant progress in characterizing the means used by living systems to more optimally extract/integrate their wealth of sensory information. It is expected that further success would permit: (1) the development of more robust signal processors that are selectively sensitive to informative channels and simultaneously robust relative to distractions and distortions; (2) the realization of multiple channel sensory fusion combining information from multiple dimensions and multiple channels to form unified representations of complex objects; (3) optimal designs for communicative signals and for allocation of effort in response to demands, needs, resources and threats; (4) expectation guided signal detection and target anticipation; and (5) methods for optimal data presentations. Proposals are sought: (1) to implement significant inferred or derived strategies in hardware/software and (2) to evaluate the potential impact on military systems of alternative strategies where substantial and significant experimental and analytical work has already been completed at the level of the living organism.

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

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

DARPA 91-110 TITLE: Biomimetic Design

CATEGORY: Basic Research

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

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

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

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

DARPA 91-111 TITLE: Environmental Science

CATEGORY: Exploratory Development

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

DESCRIPTION: There is a growing awareness and concern within DoD regarding the creation and/or perpetuation of environmentally hazardous conditions that may have been established by DoD or its contractors as a consequence of research, development, manufacturing, testing, operation/use, maintenance and demilitarization of military equipment and weapons systems/components. Analysis, development and exploitation of chemical and biological processes are of interest in this solicitation. Proposals are sought: (1) for analysis of the fate and effects of contaminants in soil and marine/estuarine environments (This includes, as appropriate, the development of analytical instrumentation and methodologies.); (2) for analysis, design and subsequent development/optimization of chemical and biomimetic pathways for remediation (This includes, for example, the characterization and stability of degradation/detoxification pathways, studies of contaminant partitioning, and the bioengineering of microbial organisms for enhanced performance and environmental robustness/suitability.); and (3) for development of alternative processes and materials for minimization/elimination of toxic waste associated with current technologies (This includes, for example, development of nontoxic antifouling coatings for naval vessels and superior coatings for aircraft, to eliminate the need for rework solvents.). Excluded for purposes of this solicitation are: (1) generalized environmental insult surveys; (2) efforts predominantly seeking only to identify or characterize the effects of hazardous waste on humans; (3) proposals to more generally characterize mesoscale environmental phenomena; and (4) those efforts that characterize general atmospheric and/or air-sea interfacial processes not specifically keyed to the two themes of the solicitation as identified above.

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

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

DARPA 91-112 TITLE: 193 nm Excimer Laser Development for Lithography

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-113 TITLE: Neural Networks Applied to Control or Diagnostic Tasks

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-114 TITLE: Advanced Analog to Digital Converter Design Studies for Wide Dynamic Range, Gigasample Conversion Rate, Monolithic Chip Architectures

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-115 TITLE: Efficient Slab Lasers

CATEGORY: Exploratory Development

OBJECTIVE: Develop efficient energy extraction from slab lasers.

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

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

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

DARPA 91-115 TITLE: High Speed Electro-optic Modulators

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-117 TITLE: Microlasers

CATEGORY: Exploratory Development

OBJECTIVE: Develop diode pumped solid state microlasers.

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

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

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

DARPA 91-118 TITLE: Tunable Coherent Infrared Radiation Source at 3-5 Microns

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-119 TITLE: Innovative Applications of Electron Beam Welding

CATEGORY: Exploratory Development

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

DESCRIPTION: Typical electron beam welding is performed with electron beam energy at less than 100 KeV and the welding is typically performed inside a vacuum chamber. This approach limits the size of the object to be welded. Moreover, the range of the electron beam in welded material is typically less than 1 mm. The use of high energy (10-20 MeV) electron beam will allow welding at atmospheric pressure and enhance the range in the welded material. Furthermore, the radiation coming from the electron beam welder can be used to monitor the process in real time.

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

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

DARPA 91-120 TITLE: Vacuum Microelectronics Development

CATEGORY: Exploratory Development

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

DESCRIPTION: Vacuum microelectronics describes a device technology based on arrays of sub-micron-size field emission sources. Presently, gated field emitter arrays have achieved values of normalized transconductance (97 Siemens/cm^2) and average electron current density (1kA/cm^2) that exceed the limits of gridded thermionic cathodes by orders of magnitude. The advent of practical high-performance gated emitters would have particular impact on microwave and mm-wave source technology. One of the main roadblocks to success is the unreliability of the current emitters. This program will emphasize the basic understanding of the factors which limit the lifetime of the emitters. Priority will be given to those designs which can overcome these obstacles.

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

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

DARPA 91-121 TITLE: Corrosion Monitor for Supercritical Water Oxidation

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-122 TITLE: Contribution/Control of Polymer Reaction in Responsive Armor

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-123 TITLE: Novel Penetrator Defeat Mechanisms for Light Armor Vehicles

CATEGORY: Exploratory Development

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

DESCRIPTION: Light armored vehicles have relatively thin hull structures of steel or aluminum with limited penetrator defeat capability. These vehicles must remain light, mobile and, in many cases, air-transportable. Of interest are new and novel penetrator defeat mechanisms that would provide the potential to up armor these vehicles without degrading their mission capability. Mechanisms that could address kinetic energy penetrators up to 30mm and hand-held chemical energy weapons would be most desireable.

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

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

DARPA 91-124 Title: Unique/Novel Lightweight Applique Armor Attachment Technologies

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-125 TITLE: Metallic Composite Armor for Light and/or Ultralight Applications

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-126 TITLE: Novel Ceramic Processing Techniques

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-127 TITLE: Fracture, Erosion and Failure Models for Armor/Antiarmor Hydrocodes

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-128 TITLE: High Power Flat Panel Light Sources for Visible Signature Control

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-129 TITLE: Optical Window Materials/Systems with High Visual and Infrared Transmissivity and High Electrical Conductivity

CATEGORY: Advanced Development

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

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

Phase I: Provide hardware samples and conduct appropriate testing.

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

DARPA 91-130 TITLE: Low-cost Optically Transparent Materials with High Thermal Conductivity

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-131 TITLE: High Payoff Mine/Barrier Concepts

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-132 TITLE: Methods to Attack Target Vehicles by Reducing or Eliminating Effectiveness of Firepower, Mobility, Communications, and/or Rendering Targets Vulnerable to Further Attack

CATEGORY: Exploratory Development

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

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

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

Phase II: Construct and test the demonstration hardware.

DARPA 91-133 TITLE: Individual Soldier Protective Ensemble Cooling

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-134 TITLE: Flexible, Deformable Surfaces Formed from Arrays of Submillimeter Sized, Linear Electromechanical Actuators

CATEGORY: Exploratory Development

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

DESCRIPTION: Micro-machines, micro-motors, and micro-actuators have been developed which are smaller than 1.0 mm^3 in volume, extremely light, and exhibit extremely rapid response times. This project seeks to explore the feasibility of using this technology to build light, adaptable surfaces which deform for some useful purpose.

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

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

DARPA 91-135 TITLE: Acoustic Sensors for Automatic Target Recognition of Ground Vehicles

CATEGORY: Exploratory Development

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

DESCRIPTION: The incorporation of an acoustic sensor system in a combat vehicle would provide a passive, non-line of sight capability with 360 degree coverage. Operating autonomously, an acoustic sensor would allow early detection and classification of approaching vehicles. The acoustic sensor could also operate in

conjunction with other sensors to provide unique target descriptors to be used in multi-sensor fusion. The goal for the acoustic sensor is that it operate mounted on a moving tank as part of a multi-sensor suite.

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

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

DARPA 91-136 TITLE: Integrated Fiber Optics/Photonics System for Netted Sensor Systems

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-137 TITLE: Fiber Optic Radio Frequency Transducers for Remote Reception of Electromagnetic Energy

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-138 TITLE: Applications of Acoustic Charge Transport Signal Microprocessor Technology

CATEGORY: Advanced Development

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

DESCRIPTION: ACT technology has evolved in recent years from a basic research activity, through the demonstration of a variety of specific devices, to the currently available "signal microprocessor." The "signal microprocessor" is a high capability, digitally programmable integrated circuit which can process analog signals by mathematical computation, thereby providing the same type of functionality for analog signals as the

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

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

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

DARPA 91-139 TITLE: Fiber Optic Transducer and Network Systems for Distributed Large Area Advanced Over the Horizon & High Frequency Receiving Systems

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-140 TITLE: Modular Architecture for Computer Image Generation

CATEGORY: Exploratory Development

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

DESCRIPTION: The computer image generator is usually the most expensive component in existing simulators. Once the user determines his requirements, he often selects the least expensive hardware that will satisfy them because of budget constraints. If requirements change (i.e., increase beyond the capabilities of his initial image generator) he is often forced to purchase a new one. A particularly desireable alternative would allow the user to build upon the equipment that he has already purchased to meet these new requirements in much the same way as a personal computer user can add memory, co-processors, graphics enhancements, etc. To make such an approach even more attractive, it should not be specific to any particular supplier of hardware.

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

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

DARPA 91-141 TITLE: Table-top, Distributed Simulation of Logistics in Battlefield Simulations

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-142 TITLE: Workstation for Parametric Analysis of Weapons/Weapons Systems in Distributed Simulation

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-143 TITLE: Adaptive Digital Array Processing for Clutter and Jammer Suppression in Spatially and Temporally Variant Environments

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-144 TITLE: Detection and Targeting Electro-optic/Infrared Imaging Sensors/Processing for Ground Targets with Suppressed Signatures

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-145 TITLE: Detection and Targeting Sensors For Ground Targets with Low Radar Cross Sections

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-146 TITLE: Application of Vitreous Materials

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-147 TITLE: Develop Numerical Approaches to Accurately Predict and Model Behind Armor Effects for Chemical Energy or Kinetic Energy Armor Penetrating Projectiles

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-148 TITLE: Nonlinear Detection of Weak Signals in Clutter

CATEGORY: Basic Research

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

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

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

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

DARPA 91-149 TITLE: Investigation of Metallurgical and Processing Effects of Implementing New Alloys for Shaped Charge Liners

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-150 TITLE: Optimizing Layer Thickness in Laminated Armors

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-151 TITLE: Aggregate Software

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-152 TITLE: Effectiveness of Metal Backplates on Ceramic Armor

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-153 TITLE: Novel Antiarmor Projectile Defeat Mechanisms

CATEGORY: Exploratory Development

OBJECTIVE: Develop novel methods for defeating antiarmor projectiles.

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

Phase I: Develop concept for novel armor system.

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

DARPA 91-154 TITLE: Hybrid Composites for Ultralight Armors

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-155 TITLE: Innovative Packaging Techniques and Package Models

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-156 TITLE: Computer Aided Design and Process Models for Microwave and Millimeter Wave Devices and Circuits

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-157 TITLE: Advanced Testing Techniques for Millimeter Wave Monolithic Integrated Circuits

CATEGORY: Advanced Development

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

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

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

Phase II: Demonstrate the usefulness of the proposed approach by building the proposed test equipment and demonstrating its ability to accurately evaluate the performance of one or more classes of millimeter wave frequency monolithic integrated circuits. Provide data on time, cost per unit test and projections for further time, and cost reductions resulting from product refinement.

DARPA 91-158 TITLE: Computer-based Display Design Tool

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-159 TITLE: High Temperature Polarizing Materials

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-160 TITLE: Color Filter Materials

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-161 TITLE: Lamps for Use as Display Backlight Sources

CATEGORY: Exploratory Development

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

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

Phase I: Develop a lamp design.

Phase II: Fabricate a prototype lamp.

DARPA 91-162 TITLE: Light Sources for Projection Display Systems

CATEGORY: Exploratory Development

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

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

Phase I: Develop a lamp design.
Phase II: Fabricate a prototype lamp.

DARPA 91-163 TITLE: Equipment for Testing Liquid Crystal Active Matrix Display Panels

CATEGORY: Exploratory Development

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

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

DARPA 91-164 TITLE: Automatic Repair Equipment

CATEGORY: Exploratory Development

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

DESCRIPTION: A common defect on matrix displays is broken or shorted line. Methods for quickly and economically adding or removing material to repair such defect would significantly enhance yield. Present processes are limited in the types of repairs they can accomplish and require tedious manual efforts. It is the intent of this topic to develop and demonstrate automatic repair equipment for repairing matrix displays by adding or subtracting material.
Phase I: Design the equipment for automatically identifying problem areas in a matrix display. Identify materials and processes that can be used to add or subtract material to repair the defects.
Phase II: Build a prototype that demonstrates the capability to identify and repair defects.

DARPA 91-165 TITLE: Antifuse Process Technology

CATEGORY: Exploratory Development

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

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

DARPA 91-166 TITLE: Modeling of Process Control Sensor Requirements for Electronics and Opto-electronics Manufacturing

CATEGORY: Exploratory Development

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

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

Development of the relationships among these variables is an essential precondition to the development of cost-effective component manufacturing.

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

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

DARPA 91-167 TITLE: Signal Processing for the Sensor-based Control of Electronic and Opto-electronics Manufacturing

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-168 TITLE: Process Control Sensor Development and Demonstration for Electronic and Opto-electronics Manufacturing

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-169 TITLE: Low-cost Cryogenic Packaging for Infrared Focal Plane Arrays

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-170 TITLE: Multiple Sensors to Control Chemical Deposition Processes and Plasma Etching of Compound Semiconductors

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-171 TITLE: On-chip Processing for Imaging Sensors

CATEGORY: Exploratory development

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

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

introduction of on-chip processing circuitry to preprocess the information. Imaging chips with analog signal and image processing customized for a particular manufacturing inspection application can reduce the cost of real-time image processing for machine vision.

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

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

DARPA 91-172 TITLE: High Speed Sensing Techniques to Determine the Surface Profiles of Materials and Components for Electronic Packaging

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-173 TITLE: In-situ Sensing and Control of High Temperature Manufacturing Processes

CATEGORY: Exploratory Development

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

DESCRIPTION: High temperature material synthesis requires the accurate measurement and control of the temperature of the material, including the temperature uniformity material. For real-time process control, temperature measurements must be performed at temperatures as high as 1000°C-1500°C without disturbing or altering the material growth process. Accurate high temperature measurements under a diverse set of process conditions is essential to the improvement material manufacturing processes for defense applications.

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

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

DARPA 91-174 TITLE: Nondestructive Material Evaluation to Determine Structural Defects and Predict Reliability

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-175 TITLE: Designs and Concepts for High Performance, Uncooled Infrared Imaging Sensors

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-176 TITLE: Designs for Multi-spectral Infrared Imaging Systems

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-177 TITLE: Infrared Focal Plane Design, with On-focal Plane Signal Processing, for Multiple System Applications

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-178 TITLE: Virtual Prototyping Tools for Semiconductor Fabrication Equipment

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-179 TITLE: Embedded Control Software for Semiconductor Process Equipment

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-180 TITLE: Novel Computer Aided Design Tools for Hybrid Systems

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-181 TITLE: Modeling, Simulation, and Control of Semiconductor Factories

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-182 TITLE: Integrated Technology Computer Aided Design

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-183 TITLE: Application Software

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-184 TITLE: Small Vocabulary Tactical Speech Recognizer

CATEGORY: Advanced Development

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

DESCRIPTION: Considerable progress has been made in the development of algorithms for large vocabulary speech recognition in benign acoustic environments. For many tactical applications, a recognizer need only deal with a small vocabulary (20-200 words) and a low (5-10) perplexity grammar, but it must operate well in a broad range of acoustic conditions (including on battlefields and inside vehicles or aircraft) and with speakers who may be under stress. In addition, such a system should require few or no prior samples of the user's

speech. Ideally, it would adapt to the speaker and the environment. The purpose of this effort is to develop a prototype tactical speech recognizer by modifying and extending the best techniques currently available.

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

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

DARPA 91-185 TITLE: Semantic Search of Information Databases

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-186 TITLE: Reusable Knowledge Bases of Engineering Designs Based on a Standard Ontology

CATEGORY: Exploratory Development

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

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

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

Phase II: Construct test cases and demonstrate the approach.

DARPA 91-187 TITLE: Reusable Knowledge Bases

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-188 TITLE: Use of Object Oriented Databases to Support Knowledge-based Planning

CATEGORY: Exploratory Development

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

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

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

Phase II: Implement and test the design.

DARPA 91-189 TITLE: Model Interface Conventions for Logistics

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-190 TITLE: Standard Machine Learning Modules

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-191 TITLE: Technology All-optical Networks

CATEGORY: Exploratory Development

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

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

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

Phase II: Construct and demonstrate a laboratory version.

DARPA 91-192 TITLE: Personal Multi-media Conferencing

CATEGORY: Exploratory Development

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

DESCRIPTION: Designs are sought for conferencing technology for existing workstations to enable teleconferencing and other forms of collaborative work, in either real-time or stored forms. Video and multi-point services are of special interest.

The technology should lead to inexpensive implementations, should provide capabilities which are extensible and can be tailored to varying communication capabilities, and should use existing media and network standards where appropriate.

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

Phase II: Construct prototypes and demonstrate capabilities.

DARPA 91-193 TITLE: Interface Technology for Switched Multimegabit Data Service

CATEGORY: Exploratory Development

OBJECTIVE: Simplify interfaces to emerging switched multimegabit data service (SMDS).

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

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

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

DARPA 91-194 TITLE: Technology for Asynchronous Transfer Module-based Internetworking

CATEGORY: Exploratory Development

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

DESCRIPTION: The basic cell-switching services of ATM will be most useful if connections can be composed of services which may be public or private, switched or dedicated, and which may span different speeds, sizes, and management domains. Designs are sought which explore such integration, including facilities for call setup and routing, resource allocation, resource guarantees and network management functions. Designs should be compatible with emerging standards.

While demonstration systems will be small and must be capable of stand-alone operation, they must be capable of operating as an integrated part of a combined ATM internet that can contain gigabit links and which can scale to millions of end-systems.

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

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

DARPA 91-195 TITLE: Interoperable Design Tools Supporting Acquisition Technology Infrastructure

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-196 TITLE: System Level Modeling Tools and Methodologies that Execute in Multiple Simulation Environments

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-197 TITLE: Rapid Prototyping Techniques That Augment Existing Design Systems

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-198 TITLE: Interoperable Technology Computer-aided Design (CAD) Tools for Electronic CAD

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-199 TITLE: High Performance, Low Cost, Multi-chip Module Design Aids that Support Multiple Technologies

CATEGORY: Exploratory Development

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

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

Phase I: Provide a detailed refinement of the proposed concept, idea and tools. Technical interfaces to various technologies should be described and demonstrations defined, if applicable, for proof of principle.

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

DARPA 91-200 TITLE: Technology Independent, High Performance Design Tools

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-201 TITLE: Object Oriented Database Implementations Consistent with Emerging ANSI X3/SPARC/OODBTG Open Architecture Interface Standards

CATEGORY: Advanced Development

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

DESCRIPTION: Current relational database technology fails to seamiessiy support the rapid data access requirements of electrical, mechanical, and software computer aided design. The fundamental difficulty is described by the term "impedance mismatch" which describes the translation software requirements which must be included to translate from object oriented programming language types into relational database queries. Currently standardization efforts are underway within the ANSI X3/SPARC/OODBTG communities. This research should address the following: 1) base level persistent C++ and CLOS data models including classes, objects, inheritance, message passing, queriable sets of objects, inversionable objects; 2) persistent object stores; 3) object communication, providing remote procedure calls and location-independent access; 4) transactional store; 5) object management; 6) object translation; 7) change management; 8) object query processing; 9) extended transaction management and 10) hypermedia interfaces.

Phase I: Develop software design for DOODB implementation.

Phase II: Demonstrate performance of a working DOODB prototype.

DARPA 91-202 TITLE: Object Oriented Image Libraries of Worldwide Military Hardware and Civilian Vehicles for Recognition and Evaluation of Image Understanding Algorithms

CATEGORY: Advanced Development

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

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

Phase I: Develop image database schema and indexing strategy.

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

DARPA 91-203 TITLE: Laboratory Grade Robotic Research Vehicle with Sensor Package and Processing Capabilities Compatible with DoD JUGVPMO Surrogate Semiautonomous Vehicle

CATEGORY: Advanced Development

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

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

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

Phase II: Demonstrate and deliver a prototype mobile robot.

DARPA 91-204 TITLE: Connector Technologies

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-205 TITLE: Memory System

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-206 TITLE: Very Large Scale Integration Cell Library

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-207 TITLE: Compiler Controlled Power

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-208 TITLE: Software Tools which Translate Software from Other Languages to Ada

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-209 TITLE: Software Tools which Re-engineer Poor Ada Systems into Optimized Ones

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-210 TITLE: Domain Specific Software Architecture Ada Reusable Software Assets

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-211 TITLE: Domain Specific Software Process Automation Technology

CATEGORY: Advanced Development

OBJECTIVE: Develop process technology including process architecture and definitions.

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

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

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

DARPA 91-212 TITLE: Software Asset Repository Technology and Composition Tools

CATEGORY: Advanced Development

OBJECTIVE: Reusable technology and tools.

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

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

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

DARPA 91-213 Title: Software Tools For Domain Specific Analysis

CATEGORY: Advanced Development

OBJECTIVE: Explore novel ideas for domain specific software tools.

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

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

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

DARPA 91-214 TITLE: Software Tools to Improve the Interaction between the Buyers and Suppliers of Non-off-the-shelf Software

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-215 TITLE: Design and Construction of Image Content-addressable Databases

CATEGORY: Exploratory Development

OBJECTIVE: Develop image content-addressable object oriented database.

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

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

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

DARPA 91-216 TITLE: Evaluation Methods and Metrics for Image Processing and Understanding Algorithms

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-217 TITLE: Standard Model-based Reasoning Modules

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-218 TITLE: Standard Decision Analysis Modules for Knowledge-based Planning Support

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-219 TITLE: User Tailorable Models for Logisitcs

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-220 TITLE: Replacement Materials for Chlorofluorocarbons

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-221 TITLE: Replacement Materials for Halon Fire Extinguishers

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-222 TITLE: Simulation of High Strain Rates for Optical Fiber

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-223 TITLE: Expert System for Computer Aided Process Planning

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-224 TITLE: High Density Connector Technology for Miniaturized Electronic Assemblies

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-225 TITLE: Transmission of 25 Watts of Gallium Arsenide Diode Laser Power Down a Fiber Optic

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-226 TITLE: System for Locating Tank Mounted Guns

CATEGORY: Exploratory Development

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

DESCRIPTION: Any effective technology may be used that could be developed for use in the field. It is preferred that the system use some characteristic unique to gun barrels (long metal tubes 3" to 4" in diameter). The original stated requirements were: scout vehicle optics capable of identifying a tank gun barrel (frontal aspect) that has not been fired for at least six hours, is located within a camouflaged defensive position, and is at least two kilometers (2km) away. The capability to detect but not identify the same target from four kilometers (4km+) is also required. Some early studies indicate that this requirement may be difficult to meet using solely optical means. Therefore, consider any means that promises to do the job. The following example is given to show that no means are ruled out:

An acoustical probe wave is launched into the camouflaged area suspected of containing tank with guns. The gun barrels could act like an organ pipe and produce a strong acoustical signature at its resonant frequency. The system could then use microphones to listen (electronically) for the organ pipe resonance. This resonant frequency will depend on the length of the gun barrel but is expected to be in the range of 100 to 200 Hertz. Narrowband filters (bandwidth 1 to 5 Hertz) can be used to enhance the signal to noise ratio.

The launch wave could be an impulse such as a gun being fired, or more economically from a commercially made cannon designed to scare blackbirds from strawberry fields. This device is expendable (about $500) and could be located away from the using unit. It could also double for use in psychological warfare; since the enemy would continue to wait for the other shoe to drop, sleep would be difficult.

If it were desired to operate more covertly, a one second acoustical burst at 150 Hertz (but tunable) could be launched toward the suspect area. This sound might easily pass unnoticed by the enemy since hearing sensitivity is down 30 db at 150 Hertz as compared to the 1000 to 5000 Hertz. That is a 1000 fold advantage. If the hum were heard, the long wavelength makes it very difficult to perceive the location of the source. The source for this single frequency acoustical energy might be a powerful loud speaker, a motor driven diaphragm, or an air driven trumpet like horn.

If gun barrel echoes were received, it is important that it be possible to locate the source of the echo. This could be done by having two or more receivers which could time the arrival of the echoes. The arrival time would place the location some where along an ellipse having the sound launcher as one focus and the

receiver as the other focus. With two receivers, there would be a second ellipse with a different focus. The gun is located where the two ellipses intersect. With three receivers there would be a confirming ellipse. This is an easy calculation for an ordinary personal computer.

It should be noted that the same equipment could be used passively when the enemy fires the guns. The guns can be located even when the muzzle flash is not observed. This would also yield moderately accurate range information. The attenuation of sound may defeat this method at ranges greater than one idlometer.

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

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

DARPA 91-227 TITLE: Development of a Compact Hardened Dye Laser

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-228 TITLE: Spatial Light Modulator Utilizing Deformable Mirror Devices for Infrared Projection for Hardware-in-the-Loop Simulation Applications

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-229 TITLE: Infrared Signal Combining Techniques For Multicolor Projector Applications

CATEGORY: Exploratory Development

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

DESCRIPTION: Several weapon systems are currently under development throughout all branches of DoD which utilize multiple IR wavebands for target detection and intercept. Conventional beam combiner techniques

result in large losses in the two projected IR signals. In addition to difficulties in generating the IR signals, these performance limitations have forced the exclusion of the IR detectors from the HWIL simulations which are necessary to adequately assess weapon system performance. Therefore, innovative IR projection techniques are needed to overcome these limitations.

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

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

DARPA 91-230 TITLE: Infrared Laser Diode Based Infrared Projector

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-231 TITLE: Ultra Low Cost Fuel Control System for Expendable Turbojet Engines

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-232 TITLE: Technologies for Intensifying High Density Charge Coupled Device Detectors

CATEGORY: Advanced Development

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

DESCRIPTION: High density CCD detectors are available in both (1024x1024) and (2048x2048) configurations with pixal sizes equal to and less than 9 microns x 9 microns. Specialized low light level applications require that these detectors be intensified. Current generation intensifiers utilize optical fibers approximately 30 microns in diameter and therefore are presently unsuitable for use with high density CCD detectors.

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

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

DARPA 91-233 TITLE: Technologies for Obtaining Real-time Readoff Rates for High Density Charge Coupled Device Detectors

CATEGORY: Exploratory Development

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

DESCRIPTION: CCD detectors in (1024x1024) configurations are available with real-time read off rates of 30 frames per second. High density CCD detectors in (2048x2048) configurations are available but not with real-time readoff rates.

Phase I: Analyze relevant technologies and formulate a concept for obtaining a 30 frame per second readoff rate for high density CCD detectors in (2048x2048) configurations. The analysis should include performance, manufacturability, and cost assessments of the proposed concept and experiments to confirm key physical assumptions.

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

DARPA 91-234 TITLE: Small, Low-cost Fiber Optic and Discrete Sensors for Remote Sensing of Temperature, Smoke, Flame and Concentrations/Partial Pressures of Organic and Nonorganic Compounds

CATEGORY: Advanced Development

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

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

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

Phase II: Demonstrate selected sensor concept.

DARPA 91-235 TITLE: Innovative Electro-optical Sensor Development to Detect From Airborne Platforms, Small Scale Vertical Airmass Movements and Velocity Gradients in Clear Air

CATEGORY: Advanced Development

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

DESCRIPTION: DARPA is investigating advanced technologies for detecting clear air turbulence (CAT) from onboard airborne platforms, both manned and unmanned vehicles. CAT is a physical phenomena characterized by mechanically induced turbulent flow from strong winds flowing over terrain features, as well as from wind shear between airmasses moving at different velocities. The horizontal and vertical extent of CAT cells can be on the order of 10s of meters, while having differential velocities of 100's of meters per second. These localized disturbances provide no visible cues to size, location and intensity. Yet the severity of the CAT can degrade mission performance, or even damage and destroy airborne platforms encountering them. Airborne sensing of the CAT prior to transit of the disturbance would provide air vehicles the option of avoiding vice transiting the CAT cell. DARPA is interested in innovative sensor and processing technologies to detect and

classify small scale airmass movements and velocity gradients from onboard airborne platforms. Possible approaches could include use of electro-optical emitters and detectors coupled with innovative signal processing techniques. Strong emphasis will be placed on truly innovative concepts that offer the potential for significant improvement in capability, even if there is technological risk. Proposals must include a discussion of how the technology would be operationally utilized.

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

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

DARPA 91-236 TITLE: Low-cost, Man-portable Real-time Weather Satellite Data Receiving, Processing and Display Technology

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-237 TITLE: Low-cost, Miniature Tactical Jammers

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-238 TITLE: Light-weight, High Efficiency, Space Qualified, Flexible Solar Array Technology

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-239 TITLE: High Energy-density Fuel and Oxidant Storage for Fuel Cell Systems Suitable for Undersea Vehicle Applications

CATEGORY: Advanced Development

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

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

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

Phase II: Complete a convincing demonstration.

DARPA 91-240 TITLE: Airborne Sensors for the Detection of Clear Air Turbulence from Sea Level to 100,000 Feet

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-241 TITLE: Low Cost, Low Weight Icing Detectors and Anti-icing Devices for Unmanned Autonomous Vehicles

CATEGORY: Exploratory Development

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

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

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

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

DARPA 91-242 TITLE: Low Cost, Portable Automatic Landing System for Unmanned Autonomous Vehicles

CATEGORY: Advanced Development

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

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

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

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

DARPA 91-243 TITLE: Manufacturing Methods for Low Cost, High Quality Unmanned Autonomous Vehicle Airframes

CATEGORY: Advanced Development

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

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

will be examined for cost effectiveness, utility, and ease of implementation. Specific enhancements will be implemented in small scale demonstrations. High payoff techniques will then be applied to production systems.

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

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

PRIOR YEARS RESULTS OF DOD SBIR PROGRAM

FY 83 - FY 90	Number of Topics	Proposals Received	Phase I Awards	Phase II Awards
ARMY	1758	14696	1676	453
NAVY	1719	13434	1769	480
AIR FORCE	1739	15399	2121	581
DARPA	313	3216	482	53
DNA	79	1259	185	26
SDIO	89	3939	796	171
	5,697	51,943	7,029	1,764

FY 91.1	Number of Topics	Proposals Received	Number Selected for Phase I Negotiations
ARMY	30	700	NOT YET RECEIVED
NAVY	290	2246	
AIR FORCE	202	2200	
DARPA	83	600	
DNA	20	255	
SDIO	15	630	
	640	5,931	

TO: _____
Fill in firm's name and mailing address

SUBJECT: SBIR Solicitation No. 91.2
Topic No._____
Fill in Topic No.

This is to notify you that your proposal in response to the subject solicitation and topic number has been received by

_____
Fill in name of organization to which you will send your proposal.

_____ _____
Signature by receiving organization Date

To: SBIR Participants

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For assistance in the preparation of informed proposals addressing the topics presented in the DoD SBIR Program Solicitation, you are encouraged to request annotated bibliographies of technical reports from the Defense Technical Information Center (DTIC). The cited reports cover selected prior DoD-funded work in related areas. Reasonable numbers of these reports may be obtained at no cost from DTIC under the SBIR Program. You will also receive information on related work-in-progress, and references to other information resources.

Complete the request form, fold, stamp and mail. Please bear in mind that significant mailing delays can occur, please order early.

DTIC authorization to provide this service expires July 1, 1991, the DoD SBIR Program Solicitation closing date.

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ORGANIZATION NAME_____

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Send technical reports bibliographies on the following SBIR topics:

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Company Status: I confirm that the business identified above meets the SBIR qualification criteria presented in Section 2.2 of the DoD Program Solicitation No. 91.2.

This is our first request during the current solicitation: yes____no____.

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Signature of Requester

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