PROGRAM ANNOUNCEMENT

US ARMY RESEARCH OFFICE

Broad Agency Announcement

W911NF-10-R-0008

FY 2010 Historically Black Colleges and Universities (HBCUs)
Partnership in Research Transition (PIRT) Program

Issued: July 2010

Proposals Due: October 22, 2010

OVERVIEW INFORMATION

- **Federal Agency Name(s) –** US Army Research Laboratory, US Army Research Office, Technology Integration and Outreach Division

- **Funding Opportunity Title -** Fiscal Year (FY) 2010 Historically Black Colleges and Universities Partnership in Research Transition Program (PIRT)

- **Announcement Type -** This is the initial announcement.

- **Funding Opportunity Number -** W911NF-10-R-0008

- **Catalog of Federal Domestic Assistance (CFDA) Number(s) -** 12.431, Basic Scientific Research

- Dates – White Papers**: August 16, 2010**
  Full Proposals: **October 22, 2010**

I. FUNDING OPPORTUNITY DESCRIPTION

In accordance with Section 252 of the National Defense Authorization Act for Fiscal Year 2010 (enacted in 10 U.S.C. 2362) and the Department of Defense Appropriation Act, 2010, the Department of Army announces the fiscal year 2010 Partnership in Research Transition (PIRT) Program. The program is executed under policy and guidance of the Office of the Assistant Secretary of the Army (Acquisitions, Logistics and Technology) and administered through the Army Research Office (ARO). The PIRT is established as the second phase of what was previously known as the Battlefield Capability Enhancement (BCE) Centers of Excellence.

The principal objective of PIRT has changed from that of the original BCE Centers. It is now to enhance programs and capabilities of a select number of high-interest scientific and engineering disciplines through Army-relevant, topic-focused, near-transition-ready innovative research. Furthering the Army Research Laboratory's (ARL) policy of advocating and supporting research at Historically Black Colleges and Universities (HBCUs) and consistent with the stated mission of the White House Initiative on HBCUs, a secondary objective of PIRT is "to strengthen the capacity of HBCUs to provide excellence in education" and to conduct research critical to the national security functions of the Department of Defense (DoD).

This publication constitutes a Broad Agency Announcement (BAA) as contemplated in Federal Acquisition Regulation (FAR) 6.102(D) (2) and Department of Defense Grant and Agreement Regulations (DODGARS) 22.315. A formal Request for Proposals (RFP), solicitation, and/or additional information regarding this announcement will not be issued.

The Army Research Office (ARO) will not issue paper copies of this announcement. The Department of the Army, ARO and other Army agencies involved in this program reserve the right to select for award all, some or none of the proposals submitted in response to this announcement. ARO and other participating Army agencies provide no funding for direct reimbursement of proposal development costs. Technical and cost proposals (or any other material) submitted in response to this BAA will not be returned. It is the policy of ARO and participating Army agencies to treat all proposals as sensitive competitive information and to disclose their contents only for the purposes of evaluation.

The FY 2010 PIRT competition is for the eleven (11) topics listed below. Detailed descriptions of the topics can be found in Section VIII entitled "Specific PIRT Topics", of this Broad Agency Announcement (BAA). The detailed descriptions are intended to provide the proposer a frame of reference and are not meant to be restrictive to the possible approaches to achieving the goals of the topic and the program. Innovative ideas addressing these research topics are highly encouraged.

1. Decision Support – Sensor to Commander
2. Multiscale Modeling of Cementitious Materials
3. Collaborative Sensemaking and Visualization for Tactical Decision Makers in Mobile Ad Hoc Networks
4. Extracting Social Content from African Languages (E-SCALES)
5. Exploitation Algorithms for Penetrating Radar for Landmine and IED Detection
6. Lower Atmospheric Research Using Lidar Remote Sensing
7. Improving Battlefield Weather Forecasts in Complex Terrain through Improved Numerical Modeling, Understanding and Applications
8. Essential Elements of Immersion in Simulated Environments
9. Advancing Human and Technology Based Search Methods for Improvised Explosive Devices and Mines
10. Fabrication of Robust Microsystem Structures (FORMS)
11. Technologies for Subterranean Void Detection Phenomenology

II. AWARD INFORMATION

Approximately $3 million per year, pending out-year appropriations, is expected to be available to fund no more than five centers in the eleven topic areas. All awards will be based on merit competition that includes evaluation by scientists and engineers of the Department of Army. **Depending on the results of the proposal evaluation, there is no guarantee that any of the proposals submitted in response to a particular topic will be recommended for funding. On the other hand, more than one proposal may be recommended for funding for a particular topic.** It is anticipated the awards will be made in the form of cooperative agreements.

PIRT awards will be supported at a baseline level of $500K or $600K per year with yearly options for additional research efforts of up to an additional $400K. All awards, including yearly options, are contingent upon the availability of funds, the specific topic and the scope of the proposed research. If instrumentation/equipment is necessary to carry out the proposed research, it must be budgeted in the first 12-month period and shall not exceed $200K. Each individual award will be for a base period of three years with two one-year options. Options may be exercised only if it is determined that adequate progress/transition is accomplished as evaluated against specific criteria such as technology transitions, peer-review papers published, number/length of sabbaticals/internships, or laboratory square footage increased, and availability of funds. It is strongly recommended that potential proposers communicate with the Research Topic Chief before the submission of a formal proposal.

III. ELIGIBILITY INFORMATION

1. Eligible Applicants

This PIRT competition is open only to covered institutions identified in the U.S. Department of Education Postsecondary list for Historically Black Colleges and Universities. The list is available at: http://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst-list-pg2.html. Questions concerning the list must be directed to the U.S. Department of Education at (888) 863-6515.

2. **Cost Sharing or Matching -** Cost sharing or matching is not a requirement.

3. **Other -** Sub-awards to non-HBCUs and/or industry are allowable for up to 30 percent of the annual budget to encourage and facilitate symbiotic relationships and transition opportunities.

IV. APPLICATION AND SUBMISSION INFORMATION

1. Application and Submission Process:

The proposal submission process is in two stages. Prospective awardees are encouraged to submit white papers to minimize the labor and cost associated with the production of detailed full proposals that have very little chance of being selected for funding. Based on an assessment of the white papers, the responsible Research Topic Chief will provide informal feedback notification to the prospective awardees to encourage or discourage them to submit full proposals.

Due Date: The due date for white papers is no later than 4:00 P.M. Eastern Time on **Monday, August 16, 2010**. White papers arriving after the deadline may not receive feedback prior to full proposal submission. However, all full proposals submitted under the terms and conditions cited in the BAA will be reviewed.

A. Submission of White Papers:

White papers may be submitted via e-mail, via the United States Postal Service (USPS), via a commercial carrier or may be hand delivered to the attention of:

Ms. Peggy A. Lacewell
Program Specialist
HBCU/MI Programs
E-mail Address: peggy.lacewell@us.army.mil

Mailing Address:
US Army Research Office
4300 South Miami Boulevard
Durham, NC 27703
Telephone (if needed): 919 549 4339

NOTE: White papers sent by fax will not be considered.

Please clearly mark the responsible Research Topic Chief (see Section VIII) as white papers will be provided to the named individual.

Evaluation/Notification: Initial evaluations of the white papers will be issued on or about **Tuesday, September 7, 2010**.

White Paper Submission: Format and Content of Applications

The white papers submitted under this BAA are expected to be unclassified basic research. The submissions will be protected from unauthorized disclosure in accordance with FAR 15.207, applicable law, and DoD regulations. Proposers are expected to appropriately mark each page of their submission that contains proprietary information. Cooperative agreements awarded under this announcement will be

unclassified.

White paper format should be as follows:

- Paper size – 8.5 x 11 inch paper
- Margins – 1 inch
- Spacing – single
- Font – Times New Roman, 12-point
- Number of Pages – no more than four (4) single-sided pages (excluding cover letter, cover page, and curriculum vitae). **Pages exceeding the page limit will not be evaluated.**

White Paper content should be as follows:

- A one page cover letter (optional)
- A cover page, labeled "PROPOSAL WHITE PAPER," that includes the BAA number, proposed title, and proposer's technical point of contact, with telephone number, facsimile number, e-mail address, and topic title. Please include the name of the Research Topic Chief.
- Identification of the research and issues
- Proposed technical approaches
- Potential impact on DoD capabilities
- Deliverables
- Potential team and management plan
- Summary of estimated costs
- Curriculum vitae of key investigators (not to exceed three (3) pages each)

The white paper should provide sufficient information on the research being proposed (e.g., hypothesis, theories, concepts, approaches, data measurements and analysis, etc.) to allow for an assessment by a technical expert. **It is not necessary for white papers to carry official institutional signatures.** White papers should be stapled in the upper left hand corner; plastic covers or binders should not be used. Separate attachments, such as individual brochures or reprints, will not be accepted.

Copies – one (1) original and two (2) copies

Important Notes Regarding Submission of Hard Copy White Papers Not Submitted via Email:

If the Offeror is using USPS, please allow an additional five (5) business days for the package to be delivered to the address provided due to USPS mail being sent to a central location for special processing before it is sent to this address.

B. Submission of Full Proposal:

Full proposals must be submitted electronically through grants.gov no later than 4:00 P.M. Eastern Time on **Friday, October 22, 2010.**

Any Offeror may submit a full proposal even if its white paper was not identified as being of "particular value" to the Government. However, the initial evaluation of the white papers should give prospective awardee some indication of whether a later full proposal would likely result in an award.

NOTE: Full Proposals sent by fax, e-mail, USPS, commercial carrier or hand delivery will not be considered.

Registration Requirements for Grants.gov: There are several one-time actions your organization must complete in order to submit applications through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider, register with Grants.gov, and obtain approval for an Authorized Organization Representative (AOR) to submit applications on behalf of the organization). Go to http://www.grants.gov/applicants/get_registered.jsp for further information. Use the Grants.Gov Organization Registration Checklist, which may be accessed at http://www.grants.gov/assets/OrganizationRegCheck.pdf to guide you through the process. Applicants who are not registered with CCR and Grants.gov should allow at least 21 days to complete these requirements. It is suggested that the process be started as soon as possible.

Questions: Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov**.**

Content and Format of Full Proposals

The full proposals submitted under this BAA are expected to be unclassified basic research. The proposal submissions will be protected from unauthorized disclosure in accordance with FAR 15.207, applicable law, and DoD regulations. Proposers are expected to appropriately mark each page of their submission that contains proprietary information. Cooperative agreements awarded under this announcement will be unclassified.

Grants.gov Full Proposal Submission: Content and Format of Applications

Application forms and instructions are available at Grants.gov. To access these materials, go to http://www.grants.gov, select "Apply for Grants", and then select "Download Application Package". Enter CFDA - 12.431 and the funding opportunity number, designated as "research opportunity number" on page two of this announcement. Each topic in this announcement has a Research Topic Chief.

Content and Form of Application – SF 424 (R&R)

You must complete the mandatory forms and applicable optional forms (e.g., SF-LLL Disclosure of Lobbying Activities) in accordance with the instructions on the forms and the additional instructions below**. Files that are attached to the forms must be in Adobe Portable Document Format (PDF) unless otherwise specified in this announcement.**

FORM: SF 424 (R&R) (Mandatory) – Complete this form first to populate data in other forms. Authorized Organization Representative (AOR) usernames and passwords serve as "electronic signatures" when your organization submits applications through Grants.gov. By using the SF 424 (R&R), proposers are providing the certification required by 32 CFR Part 28 regarding lobbying as contained in Section VI.

FORM: Research & Related Senior/Key Person Profile (Mandatory) - Biographical sketches for the Principal Investigator and for other key personnel (not to exceed three (3) pages each). Please be sure to include education and years.

To attach biographical sketches, click "Add Attachment."

FORM: Research & Related Other Project Information (Mandatory) - Complete questions 1 through 6 and attach files. The files must comply with the following instructions:

Project Summary/Abstract (Field 7 on the form) - The project summary/abstract should be a **single page** that identifies the research problem, technical approaches, anticipated outcome of the research, if successful, and impact on DoD capabilities. It should identify the Principal Investigator, the university and other universities involved in the PIRT team if any, the proposal title, the PIRT topic number and the total funds requested from DoD for the 3-year base period, the 2-year option period and the 5-year total period. The project summary must not exceed 1 page when printed using standard 8.5" by 11" paper with 1" margins (top, bottom, left and right) with font Times New Roman, 12 point. To attach a project summary/abstract, click "Add Attachment."

Project Narrative (Field 8 on the form) -

The Following Formatting Rules Apply for Field 8

- Paper size when printed - 8.5 x 11 inch paper
- Margins - 1 inch
- Spacing -single
- Font - Times New Roman, 12 point
- Number of pages - no more than twenty-five (25) single-sided pages.

The cover, table of contents, list of references, letters of support, and curriculum vitae are excluded from the page limitations. **Pages exceeding the page limit will not be evaluated**.

Include the Following in Field 8

The first page of your narrative must include the following information:

- Principal Investigator name
- Phone number, fax number and e-mail address
- Institution, Department, Division
- Institution address
- Other universities involved in the PIRT team
- Current DoD Contractor or Grantee? If yes, provide Agency, Point of Contact, and phone number.
- Proposal title
- Institution proposal number
- Topic title
- Table of Contents: List project narrative sections and corresponding page numbers.
- Executive Summary: Provide a summary of the research problem, technical approaches, anticipated outcome of the research if successful, and impact on Army capabilities.

- Project Narrative: The project narrative should clearly detail the scope and objectives of the effort and the specific research work to be performed under the cooperative agreement if the proposal is selected for funding. It is anticipated that the proposed narrative will be incorporated as an attachment to any resultant award instrument. To this end, this project narrative must not contain any proprietary restrictions.

- Technical Approach: Describe in detail the basic science and/or engineering research to be undertaken. State the objective and approach, including how data will be analyzed and interpreted. Discuss the relationship of the proposed research to the state-of-the-art knowledge in

the field and to related efforts in programs elsewhere. Include appropriate literature citations/references. Discuss the nature of expected results. Discuss potential applications to defense missions and requirements. Describe plans for the research training of students. Include the number of full time equivalent graduate students and undergraduates, if any, to be supported each year. Discuss the involvement of other students, if any.

- Project Schedule and Milestones: A summary of the schedule of events and milestones.

- Assertion of Data Rights: A summary of any proprietary rights to pre-existing results, prototypes, or systems supporting and/or necessary for the use of the research, results, and/or prototype. Any data rights asserted in other parts of the proposal that would impact the rights in this section must be cross- referenced. If there are proprietary rights, the proposer must explain how these affect its ability to deliver research data, subsystems and toolkits for integration. Additionally, proposers must explain how the program goals are achievable in light of these proprietary limitations. If there are no claims of proprietary rights in pre-existing data, this section shall consist of a statement to that effect.

- Deliverables: A detailed description of the results and products to be delivered.

- Management Approach: A discussion of the overall approach to the management of this effort, including brief discussions of: required facilities; relationships with any sub-awardees and with other organizations; availability of personnel; and planning, scheduling and control procedures.

(a) Describe the facilities available for the accomplishment of the proposed research and related education objectives. Describe any capital equipment planned for acquisition under this program and its application to the proposed research. The budget for capital equipment should be allocated to the first year budget period. Include a description of any government furnished equipment/hardware/software/information, by version and/or configuration that are required for the proposed effort.

(b) Describe in detail proposed sub-awards to other eligible universities or relevant collaborations (planned or in place) with government organizations, industry, or other appropriate institutions. In particular, describe how collaborations are expected to facilitate the transition of research results to applications. Descriptions of industrial collaborations should explain how the proposed research will impact the company's research and/or product development activities. If sub-awards to other universities are proposed, make clear the division of research activities, to be supported by detailed budgets for the proposed sub-awards.

(c) Designate one individual as the Principal Investigator for the award, for the purpose of technical responsibility and to serve as the primary point-of-contact with an agency's Research Topic Chief. Briefly summarize the qualifications of the Principal Investigator and other key personnel to conduct the proposed research.

(d) List the amount of funding and describe the research activities of the Principal Investigator and other key personnel in on-going and pending research projects, whether or not acting as Principal Investigator in these other projects, the time charged to each of these projects, and their relationship to the proposed effort.

(e) Describe plans to manage the interactions among members of the proposed research team.

(f) Identify other parties to whom the proposal has been, or will be sent, including agency contact information.

- List of References: List publications cited in above sections.

- Curriculum Vitae: Include curriculum vitae of the Principal Investigator and other key personnel (not to exceed three (3) pages each).

All applications should be in a single PDF file. To attach a Project Narrative in **Field 8**, click "Add Attachment."

Bibliography & References Cited (Field 9 on the form)

This field not required.

Facilities & Other Resources (Field 10 on the form)

This field not required.

Equipment (Field 11 on the form)

This field not required.

Other Attachment (Field 12 on the form)

Attach budget proposal at **Field 12**. You must provide a detailed cost breakdown of all costs, by cost category, and by task/sub-task corresponding to the task number in the proposed project narrative which was provided in **Field 8** of the Research and Related Other Project Information Form.

Elements of the budget should include:

- Direct Labor - Individual labor category or person, with associated labor hours and unburdened direct labor rates.

- Indirect Costs (Overhead, General and Administrative, and Other: Provide the most recent rates, dates of negotiations, the period to which the rates apply, and a statement identifying whether the proposed rates are provisional or fixed. If the rates have been negotiated by a Government agency, state when and by which agency. Include a copy of any current indirect rate agreement.

  Note: In accordance with the Limitation of Payments for Indirect Costs (DoD Defense Appropriation Act 2010), no funds made available under this act may be used to pay indirect costs that exceed thirty-five percent of the total amount of the agreement for basic research.

  Indirect costs exceeding thirty-five percent of the total amount to be reimbursed from that appropriation will be considered unallowable and will not be reimbursed. If subsequent audit indicates indirect costs exceeding thirty-five percent of the total amount paid from this appropriation have been dispersed, the recipient will refund the amount over the statutory limitation to the Government.

- Travel - Identify any travel requirements associated with the proposed research and define its relationship to the project. List proposed destinations, duration, cost estimate, and basis of cost estimate. Domestic travel must not exceed $2,500 per year per principal investigator. Special approval is required for foreign travel which is limited to $1,800 per year per principal investigator.

- Subcontract - A cost proposal as detailed as the proposer's cost proposal will be required to be submitted by the subcontractor.

- Consultant - Provide a consultant agreement or other document that verifies the proposed loaded daily/hourly rate. Include a description of the nature of and the need for any consultant's participation. Strong justification must be provided, and consultants are to be used only under exceptional circumstances where no equivalent expertise can be found at a participating university. Provide budget justification.

- Materials - Specifically itemized with costs or estimated costs. An explanation of any estimating factors, including their derivation and application, shall be provided. Include a brief description of the proposer's procurement method to be used (competition, engineering estimate, market survey, etc.). Provide budget justification.

- Other Direct Costs – Provide an itemized list of all other proposed other direct costs such as laboratory fees, report and publication costs, and the basis for the estimates (e.g., quotes, prior purchases, catalog price lists).

Funding breakdown by task/sub-task corresponding to the task number in the proposed project narrative was provided in **Field 8** of the Research and Related Other Project Information Form must also be attached.

Proposal Receipt Notices

Proposal Receipt Notices –After a proposal is submitted to Grants.gov, the Authorized Organization Representative (AOR) will receive a series of three emails from Grants.gov. The first two emails should be received within 24 to 48 hours after submission. The first email will confirm receipt of the application by the Grants.gov system and the second will indicate that the application has either been successfully validated by the system prior to transmission to the grantor agency or has been rejected due to errors. A third email should be received once the agency has confirmed receipt of the proposal. The document, Tracking Your Application Package, located at: http://www.grants.gov/assets/TrackingYourApplicationPackage.pdf explains this process.

It is recommended that applications be submitted 24-48 hours prior to the due date and time to avoid delays caused by high system usage immediately prior to the due date and time and/or other potential electronic submission problems.

C. Significant Dates and Schedule of Events:

Event	Date	**Time**
White Papers Due	**August 16, 2010**	**4:00 PM Eastern Time**
Notification of Initial DoD Evaluations of White Papers	**September 7, 2010***	
Full Proposals Due	**October 22, 2010**	**4:00 PM Eastern Time**
Notification of Selection for Award	**February 4, 2011***	
Start Date of Cooperative Agreement	**March 1, 2011***	

***These dates are estimates as of the date of this announcement.**

D. Submission of Late Proposals:

Late Submission of Proposals – Any proposal submitted through Grants.gov where the date and time of submission (as recorded in the first email from Grants.gov) is after the specified deadline for proposal submission, will be considered late and will not be evaluated unless the Grants.gov website was not operational on the due date and was unable to receive the proposal submission. If this occurs, the time specified for the receipt of proposals through Grants.gov will be extended to the same time of day specified in this BAA on the first workday on which the Grants.gov website is operational.

V. APPLICATION REVIEW INFORMATION

1. Evaluation Criteria:

A. White papers will be evaluated by the responsible Research Topic Chief to assess whether the proposed research is likely to meet the objectives of the specific topic and thus whether to encourage the submission of a full proposal. The assessment will focus on scientific and technical merit (criterion V.1.B.1 below) and relevance and potential contribution to Army (criterion V.1.B. 2 below), although the other criteria may also be used in the assessment.

B. Full proposals responding to this BAA in each topic area will be evaluated using the following criteria. The first four evaluation factors are of equal importance.

1) Scientific and technical merits of the proposed basic science and/or engineering research;

2) Relevance and potential contributions of the proposed research to the topical research area and to Department of the Army missions;

3) Identification of collaboration and transition partners and potential for technology transition; and

4) Potential impact of plans to enhance the institution's ability to perform defense-related research and to train, through the proposed research, students in science and/or engineering (for example, by acquiring or refurbishing equipment that can support Department of the Army research and research-related educational objectives).

C. The following four evaluation criteria are of lesser importance than the above four but are equal to each other:

1) The qualifications and availability of the principal investigator and other key research personnel (for example, peer-reviewed publications, experience, capabilities, research accomplishments, science/engineering accreditation, or identified strategy to achieve);

2) The adequacy of current or planned facilities and equipment to accomplish the research objectives;

3) The impact of past, present or proposed interactions with other organizations engaged in related research and development, in particular Department of the Army laboratories, industry, and other organizations that perform research and development for defense applications; and

4) The realism and reasonableness of cost. (Cost sharing is not a factor in the evaluation).

2. Evaluation Panel:

A. White papers will be evaluated either solely by the responsible Research Topic Chief for the specific topic or by an evaluation panel chaired by the responsible Research Topic Chief. An evaluation panel will consist of technical experts who are Government employees.

B. Full proposals will be evaluated by an evaluation panel chaired by the responsible Research Topic Chief for the particular topic and will consist of technical experts who are Government employees. Evaluation panel members are required to sign "no conflict of interest" and non-disclosure certifications.

3. Selection Process:

Full proposals will undergo a multi-stage evaluation procedure. The respective evaluation panels will review proposals first. Findings of the evaluation panels will be forwarded to senior Department of the Army officials who will make final selections. ARO will send written notification via e-mail to all Principal Investigators who submitted a proposal.

VI. AWARD ADMINISTRATION INFORMATION

1. Award Notices

The notification of a successful proposal must not be regarded as an authorization to commit or expend funds (except at the recipient's own risk, to the extent that the recipient elects to charge up to 90 days of preaward costs, as permitted under paragraph 32.25(d)(2)(i) of 32 CFR Part 32). The Government is not obligated to provide any funding until a Government Grants Officer signs the award document.

2. Administrative and National Policy Requirements

Lobbying – Federal regulations (Appendix A to 32 CFR Part 28) require certification regarding lobbying at the time of proposal submission. By signing and submitting the required cover page (SF 424 R&R), the proposer is certifying compliance with this regulation, which provides:

a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

3. Reporting Requirements

In general, for each cooperative agreement award, annual reports and a final report are required summarizing the technical progress and accomplishments during the performance period, as well as any other reports as requested by the Research Topic Chief (i.e. , copies of all publications, graphic materials for presentations).

4. Equipment

In compliance with the provisions of 31 U.S.C 6306 and with the intent of this program to increase university capabilities in Science, Technology, Engineering, and Math (STEM) education and/or research capabilities, title to equipment will be vested with the university without further obligation to the government.

5. Central Contractor Registration Database (CCR)

In accordance with DOD policy, prospective grantees must be registered in the Central Contractor Registration (CCR) database prior to award of a cooperative agreement. By submission of an offer resulting from this BAA, the offeror acknowledges the requirement that a prospective grantee must be registered in the CCR database prior to the award, during performance, and through final payment of any cooperative agreement resulting from this BAA. The CCR may be accessed at http://www.ccr.gov. Assistance with registration is available at 1-888-227-2423.

VII. AGENCY CONTACT(S)

One or more Research Topic Chiefs are identified for each specific PIRT topic. Questions of a technical nature shall be directed to one of the Research Topic Chiefs identified in Section VIII entitled "Specific PIRT Topics" of this BAA.

Questions of a *policy nature* shall be directed to the following:

Mr. Michael Caccuitto
Division Chief
Technology Integration and Outreach Division
US Army Research Office
E-mail Address: michael.caccuitto@us.army.mil

Mailing Address:
US Army Research Office
4300 South Miami Boulevard
Durham, NC 27703

OR

Dr. Vallen Emery
Minority Outreach Program Manager
US Army Research Laboratory
E-mail Address: vallen.emery@us.army.mil

Mailing Address:
US Army Research Laboratory
2800 Powder Mill Road
Adelphi, MD 20783

Questions of a *business nature* shall be directed to the following:

Ms. Vonetta Goodson
Contracting Officer
RDECOM Contracting Center-RTP Division
E-mail Address: vonetta.goodson@us.army.mil

Mailing Address:
US Army Research Office
4300 South Miami Boulevard
Durham, NC 27703

VIII. SPECIFIC PIRT TOPICS

1. Topic Title: Decision Support – Sensor to Commander

Research Topic Chief: Dr. Janet Spoonamore, ARL/ARO, 919-549-4284, janet.spoonamore@us.army.mil

Background: The battlespace commander is envisioned to "see first, understand first, act first, and finish decisively". The "see first" component is accomplished, in part, through the deployment of multiple manned and unmanned sensor/intelligence systems throughout the operational environment. In addition to the assets currently planned, new technologies will undoubtedly be introduced that will increase even further the amount of information available to the commander. Decisions in operational situations require interpretation of sensor information, as well as generation of near-optimal plans of action.

Objective: Capabilities developed in this project will help the commander to "understand first" and plan more effectively. The overall objective is development of methodologies to fuse and portray critical subsets of relevant intelligence processed from large, rapidly changing data sets. Data mining and sensor data fusion approaches are not sufficient. This research emphasizes the dynamical, stochastic nature of information flow and the interaction between information processing and the commander's cognitive and decision making process. Social, cultural and human dynamic factors must be addressed and assessed with respect to accuracy, reliability and other properties. It is expected that simulation, cognitive modeling and optimization tools must be developed to support dynamic interplay in the operational decision environment.

Research Concentration Areas: Interdisciplinary research in cognitive, information modeling, simulation, mathematics, stochastic optimization, psychology, sociology, game theory, statistics, learning and network theory is needed in the following research concentration areas: (1) Develop inference models describing information flow, both physics-based sensors and human systems based data. Model should address characterizing temporal aspects of data, including Bayesian, historical-based patterns. Feedback loops must be modeled. Create representative scenarios of realistic command-level message traffic to reveal dimensions and factors. Conduct cognitive task analysis, to conceptualize tasks of the mission space, the interrelationship of information in time and space; (2) Determine social/cultural properties of information content/ flow and incorporate the effects of these properties in processing data to account for accuracy, temporal aspects, and completeness. Biases and skewed properties should be accurately modeled using alternative distributions; (3) Develop, based on numerical optimization, optimal design for sensor deployment, data collection schedules based on multi-objective pareto-optimal commander metrics, operational needs. Develop advanced numerical optimization (stochastic) to provide optimal alternative scenario planning actions to address expected sensor-based outcomes. Develop game-theory based analysis to support simulation of alternative scenario planning actions; (4) Develop and/or integrate cognitive models, based on man-machine interface protocols (visual, acoustic) for effectively communicating complex, dense, dynamic, high dimensional information so as to filter "noise" and amplify critical information. Develop models which characterize synergy between physics-based information modeling and cognitive models of human information processing and decision making; and (5) Provide summary information on the advantages, qualitative and quantitative, of using an information network-based flow approach to model and build an effective, efficient tool for command-level decision support. Evaluation should be based on realistic scenarios that include variable events and that also include at least a slice of the continuum of the tactical network. Provide recommendations for incorporation of decision support tools, alternative organizational design, deployment of specific staff resources, and other potential improvements.

Impact: Military, peace-keeping and humanitarian operations depend on many information sources, from physics-based sensors as well as human systems. Modeling information flow should be based on a network flow-based approach, providing an end-to-end characterization – sensor to commander with appropriate feedback loops. Advanced decision-support tools will allow portraying (based on filters and historically-

based projections) critical subsets of information within the large deluge of data – providing commanders alternative scenarios of recommended plans of operational actions**.**

2. Topic Title: **Multiscale Modeling of Cementitious Materials**

Research Topic Chiefs: Dr. Joseph Myers, ARL/ARO, 919-549-4245, josephd.myers@us.army.mil
Dr. Bruce LaMattina, ARL/ARO, 919-549-4379, bruce.lamattina@us.army.mil

Background: Advanced cement-based materials appeal to the Army for their potential use in protective construction and force protection. Concrete is a complex multi-component material that must be viewed from a spectrum of different length scales. Constituent materials that make up typical concrete include aggregates, cement, and fillers. However, the properties of concrete ultimately rest in the interacting properties of the cement paste binder that contains components ranging in scale from 5nm to 100mm and the predominately large scale aggregate. It is within this scale that processes related to strength, creep, permeability, and diffusion can be understood from fundamental principles. Multiscale methods are critical since the structure of macro-failure almost always begins from the structure of nano-cracking, and modeling every detail of entire structures, even at the mesoscale (let alone the nano or smaller scales), will remain computationally prohibitive for some time. There are still important unresolved theoretical and experimental issues in this field, but it is clear that work toward accurate computational modeling of the performance of these materials under a wide range of dynamic loading conditions cannot wait for all of these other issues to first be settled. Indeed, simulations will very likely be an important tool in guiding theory and in assimilating experimental insights in helping resolve these questions. Performance objectives with respect to material performance in the face of current and future threat levels can be met only through research that provides more accurate computational capabilities for these materials.

Objective: This project seeks to: (1) Develop a computational multiscale model for cementitious materials that covers the 5nm-100mm range; (2) Benchmark and tune this model against experimental data at a variety of scales, such as mesoscale crack growth rates as a function of interacting nano-cracks in neighboring representative volume elements, or shear band development; and (3) Demonstrate the progress of this work by using the model to answer one of the following force protection design questions:

- Can force protection material performance be changed through smaller scale changes and how?
- What critical force protection material properties (e.g., strength, failure, spall, damage, dynamic modulus, visco-elastic or visco-plasticity parameters) can be optimized, and how?
- What are the design requirements for material structure with respect to:
  - capabilities to predict material properties based on constituents?
  - capabilities to simulate material response on the mesoscale and below, if necessary?

Research Concentration Areas: To enable success in this project, interdisciplinary research is needed to: (1) Appropriately understand and efficiently model the physiochemical processes operating at the nanometer scale; (2) Better understand the linkage of nano-scale mechanics to larger "engineering" scales; (3) Better understand and constitutively model materials that have suffered some non-failed state of damage; (4) Help resolve the controversy between the theoretical contention that several smaller scales may contribute in a holistic way to macro behavior and the prevailing computational practice of laddering small-scale effects linearly upward through successive scales; (5) Develop an approach to tie constitutive parameters to micro-scale quantities through scale-bridging relationships; and (6) Develop rigorous deviatoric-volumetric couplings and high fidelity models in extension (tension).

Impact: Success in this project will enable the engineering design required for new force protection technologies such as simply-installed, cost-effective, non-brittle masonry wall panels for personnel, more flexible load bearing concrete spans that require less reinforcement, etc.

3. Topic Title: **Collaborative Sensemaking and Visualization for Tactical Decision Makers in Mobile ad hoc Networks**

Research Topic Chief: Dr. Elizabeth K. Bowman, ARL/CISD, 410-278-5924, ebowman@arl.army.mil

Background: In the realm of the tactical battle command network, versatility is a goal that should be approached from several pathways. The tactical battlefield relies on a mix of socio-technical dependencies that demand a resilient and robust mobile ad hoc network (MANET) capability. The challenges in fielding such a MANET are significant and include network and systems engineering, C4ISR software and hardware integration requirements, and cognitive/social requirements. The benefits that a MANET would offer to Soldiers at the tactical level support harnessing the benefits of advanced technology for understanding complex, uncertain, and dynamic social forces. It is imperative that we invest in basic research to discover the collaborative sensemaking and visualization strategies that a decision support system should support in a range of tactical mission scenarios. In such an endeavor, three questions become paramount. The first is "how can use of a networked collaboration system optimize sensemaking and decision making capabilities?" The second is "how can the tactical network provide collaborative access to knowledge, relationships of interest, geospatial and temporal considerations, and relevant alerts?" The third is "how can a network interface be customized to user preferences and mission demands?" Essentially, this research will ask: How can we use it (networked information), how can we see and understand what we get from it (collaborative visual analytics), and how can we customize settings for specific use (user defined settings)?

Objective: This proposal will explore collaborative visual analytic capabilities for human decision making in MANETs. A multidisciplinary team will investigate perceptual, cognitive, and social elements of visual representations. Mathematical and computational modeling and simulation will be used to test theoretical concepts. Empirical exploration will be used to verify theoretical propositions. The tasks in this proposal will be interdependent and synchronized in order to maximize benefit from an iterative research process: theory, modeling, experimentation.

Research Concentration Areas: Research in cognitive psychology, sociology, mathematics and computer science will be required on the following topics: (1) Identify sensemaking tasks that can be improved by collaborative visual strategies; (2) Clarify the collaboration requirements and collaborative visual analytic capabilities for tactical decision making; (3) Develop strategies for the use of collaborative visual analytic support tools in a MANET; (4) Design procedures for the implementation of sensemaking strategies and associated collaborative visual analytics using theoretical and/or prototype MANET capabilities; (5) Determine limitations of collaborative visual strategies based on the fundamental principles and dynamics of tactical MANETS. Consider the impact of scale (size/organizational/capacity/temporal demands) on interactions; (6) Develop/mature network statistics to address the relationship of the physical network performance to the sensemaking capabilities of human users. Examine linkages between quantitative and qualitative measures of network performance; and (7) Verify and validate requirements and procedures on empirical data.

Impact: Collaborative sensemaking and visualization strategies designed for networks with variable performance will stabilize and enhance tactical decision making and responsiveness to dynamic environments.

4. Topic Title: Extracting Social Content from African Languages (E-SCALES)

Research Topic Chiefs: Dr. John Lavery, ARL/ARO, 919-549-4253, john.lavery2@us.army.mil
Dr. Virginia Melissa Holland, ARL/CISD, 301-394-3001, virginia.melissa.holland@us.army.mil

Background: The United States military's Africa Command (AFRICOM) was established in 2007 with the objective of working in concert with African partners. The socio-cultural context in Africa is an important component of this work. Language carries cues about social and cultural phenomena, such as the power and status relationships among conversation participants, membership and structure of groups, and the intent to persuade toward or against certain views. Based on linguistic cues, information about social and cultural phenomena can be extracted from language. While extraction of socio-cultural information is still an open research issue, recent research has advanced beyond the stage of simple string or keyword matches and is guided by semantic rules or by statistically obtained patterns. That research has not, however, addressed indigenous African languages (other than Arabic). Recent scientific breakthroughs in content extraction for less-commonly-taught languages, the continuing development of more powerful computers, and the development of parallel bilingual aligned corpora have made it possible for natural language processing researchers to leverage mathematical modeling for one language in building models for other languages. At the same time, sociologists and sociolinguists, focusing on the social meaning of language, continue to discover patterns in language that correlate with specific social phenomena (e.g., honorific endings in Korean reflect the age and status relationships between conversants in complex ways). The incipient capabilities being developed for major world languages provide an excellent basis for allowing research in African languages to proceed rapidly.

Objective: To develop automatic procedures for deriving social meanings from open-source African language text and/or speech by identifying their associated patterns which entails detecting sociolinguistic categories of information and recognizing the linguistic markers of each category.

Research Concentration Areas: Research in linguistics (and, as a subfield, semantics), sociology, mathematics, statistics and computer science will be required on the following topics: (1) Develop quantitative procedures to identify and extract, by means of linguistic (including semantic) markers, social information categories and their meaning-related patterns from open-source text and/or speech (e.g., Internet news, newspapers, broadcasts, etc.) of at least two native languages of Africa, such as, but not limited to, Swahili, Somali, Hausa, Yoruba and Igbo, Zulu and Shona. (Arabic and the native European languages that are official languages in Africa are not included here.). The extracted meaning should relate to social characteristics such as interpersonal power, status relationships, group existence, membership, structure and leadership; (2) Clarify the applicable social and linguistic theory (ies) and context(s) for the quantitative procedures. In particular, clarify how the social/linguistic theory predicts the social meaning expressed and understood by the participants in a sociolinguistic event; correlate the social information with the linguistic material produced by event participants; (3) Design the procedures to be computationally feasible (not combinatorially expensive), scalable (linearly scalable with volume of data and with number of groups) and "data-tractable" (able to produce accurate results with only data that are realistically likely to be available); (4) Design the procedures to require only limited human guidance or, preferably, be completely automatic, without human guidance or interaction; (5) Determine tradeoffs, such as those between data volume and/or types and accuracy of prediction of the social meaning identified; (6) Determine limitations of the procedures, including data-volume- and data-type-based constraints on prediction of categories and patterns; and (7) Verify/validate the procedures on empirical data.

Impact: Understanding social meaning is important for asymmetric operations (humanitarian, peace-keeping, insurgency, etc.) because it reveals a community's strengths and weaknesses and may serve to identify its goals and motivations. Misleading Anglo-centric social assumptions can be mitigated with language- and society-specific socio-linguistic knowledge.

5. Topic Title: Exploitation Algorithms for Penetrating Radar for Landmine and IED Detection

Research Topic Chief: Dr. Anders Sullivan, ARL/SEDD, 301-394-0838; anders.sullivan@us.army.mil

Background: Science and technology (S&T) developments in wideband radar highlight the need for advanced signal processing algorithms for detecting and discriminating landmines and improvised explosive devices (IEDs) at operationally acceptable false alarm rates. One of the S&T developments has been the ARL Synchronous Impulse Reconstruction (SIRE) radar. The vehicle-based SIRE radar instantaneously covers the frequency band ranging from UHF through L-band (nominally 500 MHz thru 2500 MHz). The SIRE radar system employs two transmit antennas and a physical array of 16 receives antennas to provide the necessary aperture for sufficient cross-range resolution. The forward-looking radar mobile platform provides standoff detection and can penetrate many types of concealment including wood, drywall, cinderblock, vegetation, foam, canvas, and even the ground to a certain extent. Concurrent with developments in wideband penetrating radar hardware implementations such as the SIRE radar and others (for example, down-looking ground penetrating radars (GPR) that are commercially available); breakthroughs in signal and image processing techniques such as back projection and recursive sidelobe minimization (RSM) have led to radar image products of unprecedented quality. This level of nearly artifact-free imagery may have important implications regarding concealed target detection. Despite the great potential and advancements in the technology, exploitation algorithms are still lacking. Prior research has shown that while many landmine and IED targets can be detected in the radar imagery, many other objects, natural and manmade, can also be detected. Oftentimes these confuser objects have the same size and radar signature as the landmine or IED, prompting false alarms. Therefore, advanced exploitation algorithms are needed to reliably separate the desired targets from in-scene random clutter objects. To fully optimize the radar image and ultimately provide a militarily useful technology to the Soldier, advancements will need to be made in the areas of algorithm development and target exploitation.

Objective: The research will develop and transition fully tested algorithms and software for the detection and discrimination of landmines and IEDs for wideband penetrating radar applications. To aid in meeting this objective, Government simulation data and SIRE radar data will be provided.

Research Concentration Areas: Areas of interest include, but are not limited to: (1) Improved image formation exploitation techniques for forward looking radar; (2) Inverse scattering image formation for GPR; (3) Anomalous behavior detection for staring optical sensors (to be used for detecting IED emplacements); and (4) Fine detail change detection for sub-clutter IED detection.

Impact: The requirement this project is addressing is defined in the TRADOC top 10 Warfighter Outcomes (WFO) on Counter IED and Mine. This research will produce enabling algorithms for forward-looking and down-looking radar technologies for detecting landmines and IEDs with unprecedented reliability and accuracy. The payoff will be in enhanced survivability of Army vehicles and forces from in-road and side attack threats.

6. Topic Title: Lower Atmospheric Research Using Lidar Remote Sensing

Research Topic Chief: Mr. Melvin Felton, ARL/CISD, 301-394-2618; mfelton@arl.army.mil

Background: The US Army is currently operating lidar systems in support of a variety of DoD initiatives, e.g., Joint Precision Airdrop, chemical/biological dispersion, field artillery targeting, detection of major storm generation, etc. This is a technology capable of providing continuous environmental

information for ranges up to 20-30 km and for spatial scales down to 1-10 m. This makes lidar one of the most powerful classes of environmental remote sensing instruments. Additional research should be performed to further develop lidar-based measurements and applications.

Objective: The objective of this research is to enhance traditional lidar techniques by developing novel lidar-based measurement capabilities and demonstrate their utility in military operations and/or environmental monitoring scenarios.

Research Concentration Areas: The development of novel lidar-based measurement capabilities can be accomplished in two ways. First, novel sensor components and signal processing algorithms may be incorporated into lidar systems. This makes it possible, for example, to obtain Raman measurements which can provide temperature and atmospheric species concentration profiles. The second way to develop novel lidar-based measurement capabilities is by incorporating a lidar into a suite of instruments. This could be passive radiometric instruments or an ad-hoc network of lidars.

Impact: The enhancement of traditional lidar techniques will lead to a greater level of planetary boundary layer characterization and monitoring. Raman scattering measurements may lead to improved chemical sensing, estimates of visibility, and weather forecasting. Incorporating enhanced lidar measurements with passive radiometric measurements may also provide a means for chemical sensing in which the aerosols sensed can be properly identified, and thus give context to aerosol, water vapor, or temperature measurements. An ad-hoc network of remote sensing instrumentation, to include both ground- and aerially-based lidars, could be used for long-duration environmental remote sensing over a broad detection area, thereby providing increased situational awareness for theater-wide protection and for national security. A single lidar could be used for environmental remote sensing over the battlefield, e.g., in support of field artillery targeting, to determine instantaneous temperature and wind fields in the direction of fire, thereby eliminating the need for the weather balloon, which cannot provide the needed update rate or directionality.

7. Topic Title: Improving Battlefield Weather Forecasts in Complex Terrain through Improved Numerical Modeling, Understanding and Applications

Research Topic Chief: Dr. Patrick A Haines, ARL/CISD, 575 678-5593; patrick.haines@us.army.mil

Background: The US Army currently operates in several mountainous areas in which the ability to accurately forecast the local atmospheric conditions is limited. While there have been considerable advances in larger scale weather prediction, better understanding of and improved capability to forecast small space and time scale variations in mountains are needed. This research will examine effective assimilation of limited observations in weather prediction models, and numerical methods and model physics required for very high resolution forecasts. It must also address the uncertainty of such forecasts. To produce an accurate forecast, a numerical weather model must ingest the local observational data, integrate it into the model initialization database, and computationally account for excessive disturbances/energy efficiently via inertia-gravity waves and turbulence generated by internal model physics.

Objective: To provide the US Army and DoD the knowledge necessary to develop or modify numerical weather prediction models that will produce accurate forecasts of weather conditions at very high resolution in mountainous areas. It will also enable assessment of the uncertainty of such forecasts in a way useful to Army commanders and battlefield decision makers.

Research Concentration Areas: Areas of interest include but are not limited to: (1) Improve data representations in the model: (i) how unconventional data (LIDAR, UAS, and feature-track winds) can be

assimilated into high-resolution numerical weather forecast runs; (ii) perform nested Large Eddy Simulations (LES) for model domains with fine grid resolutions and test accuracies; and (iii) develop techniques to resolve issues with steep topography; (2) Improve numerical modeling techniques: (i) implement and test higher-order advection and time step schemes to improve model accuracy; (ii) adopt or develop numerical techniques to avoid or lessen numerical smoothing effects; (iii) investigate numerical techniques to suppress numerical instability artificially to control phase and spatial errors; (iv) perform sensitivity tests on land surface processes, PBL, microphysics, and radiation parameterization schemes for various mountainous areas of Army interest; (v) develop a better vertical coordinate methods to calculate pressure gradient forces and advection; and (3) Investigate the predictability of battlefield scale weather in mountains. The energy propagation and cascade in simulating the real atmosphere should also be compared to ensure that models are not contaminated by numerical techniques, such as smoothing and wave reflection.

Impact: Promising new sensor technologies such as coherent or direct LIDAR and Unmanned Aircraft Systems (UAS) with on-board MET instrument packages can potentially mitigate lack of observation data. This research will yield the improved numerical modeling, data assimilation and better understanding needed to fully reap the benefits of these additional measurements while also accurately accounting for the effects of complex terrain. The improved forecasts and their uncertainty will benefit Army operations in mountains ranging from improved predicted fire for artillery to more accurate delivery of supplies via precision high-release airdrop; planning and mission execution will also benefit. An urgent issue that the proposed project will address is development of a better vertical coordinate for steep terrain that avoids large errors in the pressure gradient force and advection. The research will yield improved treatment of physical processes unable to be explicitly represented and of physical boundaries that are currently accounted for with insufficient grid resolution or, in the instance of steep terrain, become increasingly incompatible with the basic modeling partial differential equations. All the foregoing deficiencies which limit current models' effective resolution and accuracy will be addressed in this topic. Finally, this research will find and test methods to assess the uncertainty of a specific localized forecast so that commanders will know how well weather predictions are expected to verify.

8. Topic Title: Essential Elements of Immersion in Simulated Environments

Research Topic Chief: Michael LaFiandra Sc.D., ARL/HRED, 410-278-5973; michael.lafiandra@us.army.mil

Background: Immersive simulation provides a means to explore new operational tactics or equipment concepts in a highly configurable, repeatable, safe manner. These tools may enhance the Army's ability to gain insight into the physical, physiological, and cognitive processes of dismounted Soldiers when placed in demanding and stressful operational situations. Much of the data that can be collected and analyzed would be difficult or impossible to gather from real world exercises. However, there is a need to understand how closely the simulated environment needs to represent the live environment so that data collected in these artificial, immersive environments accurately represents what would occur in the real environment.

Technological advances in computer graphics have enabled the creation of virtual environments that can visually immerse the user into a sense of real world presence. Typically, more effort is devoted to providing high fidelity visual stimuli with auditory stimuli added almost as an afterthought. It remains uncertain whether these stimuli are adequate to invoke the same cognitive responses as would the real world stimuli. In addition, the simulators often oversimplify or totally ignore the locomotion aspects. For applications that require or benefit from natural human locomotion through these 3-dimensional environments, interfaces such as a joystick or mouse may not be adequate. They lack the appropriate effects on the user from the physical workload of traversing terrain (spatial relationships, fatigue, psychomotor control, etc.) and distract from the psychosomatic immersion into the environment. More

natural physical interaction can be accomplished with a higher fidelity mobility platform such as the Army's Omni-Directional Treadmill (ODT) but even these devices still do not incorporate all aspects of the terrain such as grade, surface type, or obstacles. A better understanding of the effects of the physical workload and physical immersion on the performance measures is needed.

Objective: Determine the effects the level of physical interaction with the simulator has on performance of dismounted Soldier tasks and quantify the biomechanical characteristics required for a mobility interface to adequately reproduce realistic performance effects. Determine the qualities of the sensory cues necessary to fully immerse dismounted Soldiers in a simulated environment and induce realistic cognitive effects.

Research Concentration Areas: Areas of interest include, but are not limited to: Research Psychology, Human Factors, Computer Science, Biomechanics, Physiology, and Engineering.

Impact: The end product of this effort will help to ensure that simulation-based research findings on issues of critical interest to the Army are valid. It will also significantly contribute to the advancement of modeling and simulation tools necessary to capture, analyze, and evaluate the data resulting from human performance research experiments for the dismounted Soldier**.**

9. Topic Title: Advancing Human and Technology Based Search Methods for Improvised Explosive Devices and Mines

Research Topic Chief: Dr. Alan Davison, ARL/HRED, 573-563-4070; alan.d.davison@us.army.mil

Background: Improvised Explosive Devices (IEDs) are today, and will continue to be in the foreseeable future, the weapon of choice used by terrorists. Lessons learned, in Iraq and Afghanistan, clearly indicate that IEDs cannot be defeated by technology alone. U.S. Forces' success against these type of weapons will almost certainly come through a combination of enhanced technologies that can increase probabilities of detection or neutralization of devices at standoff ranges with tactics, techniques, and procedures that can rapidly adapt to ever evolving threat techniques. New, technology-dependent detection devices are being rapidly developed but are often challenging to use in tactical environments. No optimal method has been developed to teach warfighters how to visually search for IEDs or mines, even while it is widely recognized that most IEDs are visually detected. We must continue to develop the technologies, the methodologies, and the training necessary to reduce the effectiveness of IEDs and mines.

Objective: Research the benefits and challenges of combining non-technical approaches, such as optimizing human visual search techniques, while operating in parallel with technological advances. Develop training that will increase the warfighter's innate search abilities while employing new technologies in such a manner as to optimize the Soldier's role and safety in combating IEDs and mines.

Research Concentration Areas: (1) Collect near real time information from the warfighters in order to understand the current interaction of various employed technologies that must be used in parallel to the human requirements to execute tactics, techniques, and procedures; (2) Research unaided and augmented "search" strategies that may improve a warfighter's capability to detect tactical anomalies; (3) Investigate the premise that "search" skills can be trained and that such training will significantly improve probability of detection; (4) Research the changing role of warfighters today and in the future as they operate within a hybrid technology-driven and human-driven environment; and (5) Develop training to optimize this human/technology interaction.

Impact: Emerging technologies are providing significant new capabilities to detect IEDs. Yet, there is no proverbial "silver bullet" solution on the horizon. The technologies all have capabilities and

limitations. The optimization of the human/warfighter interaction with these technologies will minimize the effectiveness of terrorist use of IEDs and mines. This research effort will provide a comprehensive program to enhance the warfighter's capacity to use human capabilities along with technology, thereby enhancing the synergism of the mix.

10. Topic Title: Fabrication of Robust Microsystem Structures (FORMS)

Research Topic Chiefs: Dr. David M. Stepp, ARL/ARO, 919-549-4329; david.m.stepp@us.army.mil and Dr. Eric Wetzel, ARL/WMRD, 410-306-0851; eric.wetzel@us.army.mil

Background: Future warfighter sensing, communication, and reconnaissance activities will likely be enhanced through the use of complex, miniaturized mobile platforms with sizes of 0.1 - 10 mm. Many of the materials and components in these systems will require robust mechanical properties and complex geometric forms in order to achieve functionality. However, conventional fabrication processes for structural materials, such as casting, machining, and mechanical assembly, are inefficient and difficult to scale to these required length scales. Lithographic techniques, such as multi-layer photolithography, are expensive, complex, and amenable to only a limited set of primarily monolithic materials. These techniques are also challenging to utilize for the creation of complex but efficient 3D structural architectures, and are most typically employed for generating sub-µm structures and devices.

Objective: This topic seeks to develop the scientific foundations for designing, fabricating, and assembling structural components and systems for 0.1 - 10 mm sized mobile platforms. New fabrication approaches should be high fidelity, low cost, capable of producing 2-D and 3-D customized parts, and amenable to a range of polymeric, ceramic, metallic, and composite material systems. These concepts should include, but are not limited to, 3-D lithographic techniques, 3-D printing, embossing and roll-printing methods, micromachining, self-assembly, and robotic deposition. The techniques should be capable of replicating many of the features of conventional macro-scale structures, such as multi-material assemblies, selectively tuned and oriented mechanical properties, and utilization of structural forms such as trusses, sandwich construction, spars, membranes, and tensile structures. Biologically inspired approaches are of particular interest due to the diversity of biological systems that demonstrate efficient design at these length scales.

Research Concentration Areas: Areas of interest include, but are not limited to: (1) The development of materials with at least one characteristic dimension of 1- 100 µm that possess specific strength and stiffness values comparable to conventional bulk engineering composites and lightweight structures (i.e. high tensile stiffness and strength; high bending stiffness at low areal density); (2) The design of manufacturing techniques for creating custom components at the 10 - 1000 µm length scale with complex shapes and topographies, and micro-assembly techniques for joining these components into more complex systems at the 0.1 - 10 mm length scale; (3) The development of novel techniques for rigorous mechanical interrogation and characterization at the micro scale, including micro tensile, bending, and compression capabilities, and testing with in-situ microscopy; and (4) The design and demonstration of multiscale models capable of predicting micro-material performance and designing optimal material architectures and compositions.

Impact: The small-scale mechanically robust materials and structures targeted in this topic are directly relevant to developing new mobile and autonomous systems to support and protect the soldier. It is also expected that the fundamental knowledge generated from this effort will impact a variety of commercial and DoD applications that use small-scale structural components. In addition, this topic seeks to build new relationships that improve the capabilities of the funded institutions, their students, and Army personnel. Successful proposals will create novel and substantive opportunities for education, training, and transition. Specific educational targets include: strong representation of minority US citizens among participating graduate and undergraduate students; formalized research collaborations with majority university partners

culminating in joint authorship of peer-reviewed publications; personnel exchanges between HBCUs, majority institutions, and ARL laboratories; and inclusion of majority institution faculty and ARL scientific staff on HBCU thesis committees.

11. Topic Title: Technologies for Subterranean Void Detection Phenomenology

Research Topic Chief: Dr. Jason McKenna, ERDC, 601- 634-4685; Jason.R.McKenna@usace.army.mil

Background: Clandestine tunnels create a clear vulnerability along border areas, constitute an unchecked method of entry for the introduction of trans-nationals who may desire to carry out terrorist attacks, and are a potential avenue for the introduction of weapons of mass destruction (WMD). Current tunnel detection activities are limited to exploiting human intelligence and/or discovering construction underway and movement through existing tunnels. These methods can also require the fixed installation of a sensing infrastructure along likely avenues of tunneling activities. Known programs that directly address finding subterranean voids are primarily adaptations of means commonly used in the oil industry which concentrate on interpreting the return of signals sent into the ground. These methods are both slow and require expert interpretation. Current subterranean imaging methods are limited to 1 to 2 meters and have an approximate 50 percent false alarm rate. What is needed is a mobile, self-contained system that can detect voids a minimum of 20 meters below the surface with a false alarm rate of less than 5 percent. Such a system would take advantage of automated algorithms and software to display data in near real-time. This technology has potential future application in multiple forums, including homeland defense, combat and stability operations, infrastructure protection, as well as a host of civilian applications.

Objective: The research will provide an ability to detect, deny and aggressively alert warfighters and law enforcement of subterranean voids, both pre-existing and clandestine, in order to prevent possible use of attack. This research could lead to mobile, all-weather, all-terrain technology with a very low false alarm rate to improve survivability and provide actionable subterranean intelligence.

Research Concentration Areas: Areas of interest include, but are not limited to performance parameter definition, sensor refinement, algorithm refinement, data storage, integration of human intelligence and ground truth.

Impact: The approach will rely upon the ability to determine the locations of subterranean voids without deploying a pre-installed sensor infrastructure which will increase combat effectiveness and provide for troop safety. In the asymmetric conflicts in which we are expected to participate in the future, the ability to quickly determine tunnels, weapon caches, pre-chambered holes for future explosive emplacements, etc., will increase our warfighting effectiveness and save troop lives.

IX. OTHER INFORMATION

1. Government Facilities and Resources

Government research facilities and operational military units are available and should be considered as potential government facilities to support proposed research. These facilities and resources are of high value and some are in constant demand by multiple programs. It is unlikely that all facilities would be used for any other specific program. The use of these facilities and resources will be negotiated as the program unfolds. Offerors should explain, as part of their proposals, which of these facilities are critical for the project's success.

2. Use of Animals and Human Subjects in Research

If animals are to be utilized in the research effort proposed, the proposer must complete a DoD Animal Use Protocol with supporting documentation (copies of AAALAC accreditation and/or NIH assurance, IACUC approval, research literature database searches, and the two most recent USDA inspection reports) prior to award. Similarly, for any proposal that involves the experimental use of human subjects, the proposer must obtain approval from the proposer's committee for protection of human subjects (normally referred to as an Institutional Review Board, (IRB)). The proposer must also provide NIH (OHRP/DHHS) documentation of a Federal Wide Assurance that covers the proposed human subjects study. If the proposer does not have Federal Wide Assurance, a DoD Single Project Assurance for that work must be completed prior to award. Please see below for further information.

3. Department of Defense High Performance Computing Program

The DoD High Performance Computing Program (HPCMP) furnishes the DoD S&T and DT & E communities with use-access to very powerful high performance computing systems. Awardees of DoD contracts, grants, and assistance instruments may be eligible to use HPCMP assets in support of their funded activities if Program Officer approval is obtained and if security/screening requirements are favorably completed. Additional information and an application may be found at http://www.hpcmo.hpc.mil/.

4. Submission of Questions

Any questions regarding this solicitation must be provided to the Science and Technology Point of Contact and/or the Business Point of Contact listed in this solicitation. All questions shall be submitted in writing by electronic mail.

Answers to questions submitted in response to this solicitation will be addressed in the form of an Amendment and will be posted to one or more of the following web pages:

-Grants.gov Webpage – http://www.grants.gov/
-ARO Broad Agency Announcement (BAA) Webpage – http://www.aro.army.mil