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Defense Threat Reduction Agency (DTRA)
Small Business Innovation Research (SBIR) 23.2
Proposal Submission Instructions

INTRODUCTION

The Defense Threat Reduction Agency (DTRA) mission is to enable the DoD, the U.S. Government, and International Partners to counter and deter Weapons of Mass Destruction (WMD) Chemical Biological, Radiological, Nuclear) and Improvised Threat Networks. The DTRA SBIR program is consistent with the purpose of the Federal SBIR/STTR Program, i.e., to stimulate a partnership of ideas and technologies between innovative small business concerns and through Federal-funded research or research and development (R/R&D).

The approved FY23.2 topics solicited for the Defense Threat Reduction Agency (DTRA) Small Business Innovation Research (SBIR) Program are included in these instructions followed by the full topic description. Offerors responding to this Broad Agency Announcement (BAA) must follow all general instructions provided in the related Department of Defense Program BAA and submit proposals by the date and time listed in the DoD Program BAA. Specific DTRA requirements that add to or deviate from the DoD Program BAA instructions are provided below with references to the appropriate section of the DoD document.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

The DTRA Small Business Innovation Research (SBIR) Program is implemented, administered, and managed by the DTRA SBIR/STTR Program Office. Specific questions pertaining to the administration of the DTRA SBIR Program and these proposal preparation instructions should be submitted to:

Mr. Mark D. Flohr
DTRA SBIR/STTR Program Manager
Mark.D.Flohr.civ@mail.mil
Tel: (571) 616-6066

Defense Threat Reduction Agency
8725 John J. Kingman Road
Stop 6201
Ft. Belvoir, VA 22060-6201

For technical questions about specific topic requirements during the pre-release period, contact the DTRA Technical Point of Contact (TPOC) for that specific topic. To obtain answers to technical questions during the formal BAA open period, visit: https://www.dodsbirsttr.mil/submissions/login. For questions regarding the Defense SBIR/STTR Innovation Portal, contact DSIP Support at dodsbirsupport@reisystems.com.

Proposals not conforming to the terms of this announcement will not be considered. DTRA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DTRA will be funded. DTRA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

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Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DTRA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed 20 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages in the technical volume over 20 pages will not be considering in proposal evaluations.

Content of the Technical Volume

The Technical Volume should cover the following items <u>in the order given below</u>:

(a) Identification and Significance of the Problem or Opportunity.
Define the specific technical problem or opportunity addressed and its importance.

(b) Phase I Technical Objectives.
Enumerate the specific objectives of the Phase I work, including the questions the research and development effort will try to answer to determine the feasibility of the proposed approach.

(c) Phase I Statement of Work (including Subcontractors' Efforts)

(1) Provide an explicit, detailed description of the Phase I approach. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The 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 Technical Volume section.

(2) This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. In the event that Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all of the proper approvals have been obtained. **Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

(d) Related Work.
Describe significant activities directly related to the proposed effort, including any

conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The technical volume must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following:

(1) Short description,
(2) Client for which work was performed (including individual to be contacted and phone number), and
(3) Date of completion.

(e) 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.
(3) Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.

(f) Commercialization Strategy. Describe in approximately one page your company's strategy for commercializing this technology in DoD (such as a formal DoD Program), other Federal Agencies, and/or private sector markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this SBIR project that your company expects to achieve.

(g) Key Personnel. Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise technical resume of the principal investigator, including a list of relevant publications (if any), must be included (Please do not include Privacy Act Information). All resumes will count toward the page limitations for Volume 2.

(h) Foreign Citizens. Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Proposers frequently assume that individuals with dual citizenship or a work permit will be permitted to work on an SBIR project and do not report them. This is not necessarily the case and a proposal will be rejected if the requested information is not provided. Therefore, firms should report any and all individuals expected to be involved on this project that are considered a foreign national as defined in the BAA. You may be asked to provide additional information (e.g., copy of valid passport, visa, work permit, etc.) during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

(i) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. 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.

(j) Subcontractors/Consultants. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described to the same level of detail as the prime contractor costs. A minimum of two-thirds (66%) of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. For Phase II, a minimum of one-half (50%) of the research and/or analytical work must be performed by the proposing firm. The percentage of work is measured by both direct and indirect costs. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposer must certify their use of such facilities on the Cover Sheet of the proposal.

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. Primary employment with a small business concern precludes full-time employment at another organization.

(k) Prior, Current, or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information. Refer to the instructions provided in the DoD STTR BAA for this requirement.
Note: If this does not apply, state in the proposal "No prior, current, or pending support for Proposed work”

Cost Volume (Volume 3)
The Phase I Base amount must not exceed $167,500. For the Cost Volume, DTRA requires the use of a Microsoft excel spread sheet which is available on the DSIP portal.

Important: when completing the cost volume, enough information should be provided to allow the agency to understand how you plan to use the requested funds if a contract is awarded. Itemized costs of any subcontract or consultant should be provided to the same level as for the prime small business. If an unsanitized version of costs cannot be provided with the proposal, the Government may request it during negotiations if selected. Refer to the instruction provided in the DoD SBIR program BAA for additional details on the content of the Cost Volume.

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Note: Cost for travel funds must be justified and related to the needs of the project. DTRA does not include any fee on travel costs, so proposal should exclude fee on any travel costs proposed.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DTRA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement officer.

For more information about cost proposals and accounting standards, see https://www.dcaa.mil/Guidance/Audit- Process-Overview/.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DTRA during proposal evaluations.

Supporting Documents (Volume 5)
Volume 5 is provided for proposers to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3). Please refer to the DoD Program BAA for details on required Supporting Documents.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees.
The Phase II proposals are best submitted no later than (NLT) 30 days AFTER the end of the 7 month Phase I period of performance.

All SBIR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations.

DTRA is not responsible for any money expended by the proposer prior to contract award.

DTRA has established a **40-page limitation** for the Technical Volume for Phase II proposals. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), or the Cost Volume, or the Company Commercialization Report. The Technical Volume includes, but is not limited to: table of contents, pages left blank, references and letters of support, appendices, key personnel biographical information, and all attachments.

Further details on the due date, content, and submission requirements of the Phase II proposal will be provided either in the Phase I award or by subsequent notification.

Phase II Proposal Instructions
Each Phase II proposal must be submitted through the Defense SBIR/STTR Innovation Portal (DSIP) by the deadline as specified in the Phase II Proposal Guidelines, or in the Phase I award or subsequent notification. **The format should be similar to Phase I proposal except the Phase II Technical Proposal is limited to 40 pages.** Each proposal submission must contain a Proposal Cover Sheet, Technical Volume, Cost Volume, a Company Commercialization Report (see the appropriate section of the DoD Program BAA) and Volume 5. The Commercialization Strategy section of the technical proposal should be more specific than was required for Phase I. Refer to the DoD Program BAA for additional details.

Phase II Evaluation Criteria
Phase II proposals will be reviewed for overall merit based upon the criteria specified in the DoD Program BAA and will be similar to the Phase I process.

Public Release of Award Information
If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released via the Internet. Therefore, do not include proprietary or classified information in these sections. For examples of past publicly released DoD SBIR/STTR Phase I and II awards, visit https://www.dodsbirsttr.mil/submissions/login.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
In accordance with the Small Business Act (15 U.S.C. 632), DTRA will authorize the recipient of a Phase I or Phase II SBIR award to purchase Discretionary Technical & Business Assistance services, such as access to a network of scientists and engineers engaged in a wide range of technologies, or access to technical and business literature available through on-line data bases, for the purpose of assisting such concerns as:

- making better technical decisions concerning such projects;
- solving technical problems which arise during the conduct of such projects;
- minimizing technical risks associated with such projects;
- developing/ commercializing new commercial products/processes resulting from such projects; and,
- meeting cyber security requirements.

If you are proposing use of Discretionary Technical and Business Assistance (TABA), you must provide a cost breakdown in the Cost Volume under "Other Direct Costs (ODCs)" and provide a one-page description of the vendor you will use and the Technical and Business Assistance you will receive. For the Phase I project, the amount for TABA may not exceed $6,500 per award. For the Phase II project, the TABA amount may be less than, equal to, but not more than $50,000 per project. The description should be included in Volume 5 of the proposal.

Approval of Discretionary Technical and Business Assistance is not guaranteed and is subject to review of the contracting officer.

For Discretionary Technical and Business Assistance, small business concerns may propose one or more vendors. Additionally, business-related services aimed at improving the commercialization success of a small business concern may be obtained from an entity, such as a public or private organization or an agency or other entity established or funded by a State that facilitates or accelerates the commercialization of technologies or assists in the creation and growth of private enterprises that are commercializing technology.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic

could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

Notifications
Following the EA decision, the DTRA SBIR/STTR office will release notification e-mails of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official. Offerors may request a debriefing of the evaluation of their not-selected proposal and should submit this request via email to: dtra.belvoir.RD.mbx.sbir@mail.mil and include "SBIR 23.2 / Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions which, if successfully completed, will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without additional negotiations by the contracting officer or without opportunity for revision for proposals that are reasonable and complete.

DTRA Support Contractors
Select DTRA-employed support contractors may have access to contractor information, technical data or computer software that may be marked as proprietary or otherwise marked with restrictive legends. Each DTRA support contractor performs under a contract that contains organizational conflict of interest provisions and/or includes contractual requirements for nondisclosure of proprietary contractor information or data/software marked with restrictive legends. These contractors require access while providing DTRA such support as advisory and assistance services, contract specialist support, and support of the Defense Threat Reduction Information Analysis Center (DTRIAC). The contractor, by submitting a proposal or entering into this contract, is deemed to have consented to the disclosure of its information to DTRA's support contractors.

The following are, at present, the prime contractors anticipated to access such documentation: Broadleaf Inc (contract specialist support), Kent, Campa and Kate, Inc. (contract closeout support), ARServices (Program Management Advisory and Assistance Services--A&AS), Systems Planning and Analysis, Inc. (Subject Matter Expertise A&AS), Polaris Consulting (Small Business Program Support), Seventh Sense Consulting, LLC (Acquisition Support), Kapili Services, LLC and TekSynap (DTRIAC) and Savantage Solutions (Accounting and Financial Systems Support). This list is not all inclusive (e.g., subcontractors) and is subject to change.

Protests
Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to:

"Service of Protest (Sept 2006)
(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the Government Accountability Office (GAO), shall be served on the Contracting Officer (addressed to Mr. Herbert Thompson, Contracting Officer, as follows) by obtaining written and dated acknowledgment of receipt from (if mailed letter) Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 1680 Texas Street, Kirtland

AFB, NM 87117. If Federal Express is used for the transmittal, the appropriate address is: Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 8151 Griffin Avenue SE, Building 20414, Kirtland AFB, NM 87117-5669.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.
(End of provision)"

AWARD AND CONTRACT INFORMATION
DTRA plans on Phase I projects for a seven (7) month period of performance with six months devoted to the research and the final month for the final report. The award size of the Phase I contract is no more than $167,500.00, notwithstanding a maximum of $6,500.00 for Discretionary Technical and Business Allowance (TABA). For a Phase II project, DTRA plans on a 24 month period of performance. The award size of a Phase II contract is no more than $1,100,000.00, notwithstanding a maximum of $50,000.00 for TABA for the entire project.

ADDITIONAL INFORMATION

Export Control Restrictions

The International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, will apply to all projects with military or dual-use applications that develop beyond fundamental research, which is basic and applied research ordinarily published and shared broadly within the scientific community. More information is available at https://www.pmddtc.state.gov/ddtc_public.

The technology within some DTRA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. **The offeror must ensure that their firm complies with all applicable export control regulations.**

NOTE: Export control compliance statements found in these proposal instructions are not meant to be all inclusive. They do not remove any liability from the submitter to comply with applicable ITAR or EAR export control restrictions or from informing the Government of any potential export restriction as fundamental research and development efforts proceed.

Cyber Security
Any Small Business Concern receiving an SBIR award is required to provide adequate security on all covered contractor information systems. Specific security requirements are listed in DFARS 252.204.7012, and compliance is mandatory.

Feedback
In an effort to encourage participation in, and improve the overall SBIR award process, offerors may submit feedback on the SBIR solicitation and award process to: dtra.belvoir.RD.mbx.sbir@mail.mil for consideration for future SBIR BAAs.

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DTRA SBIR 23.2 Phase I Topic Index

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DTRA232-001 TITLE: Computational Modeling of Human Blast Injuries in the Battle Fields

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Combat Casulty care; Biotechnology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: To develop a computational modeling tool to simulate human blast injuries in the battle field

DESCRIPTION: In the battle fields, more than 90% of the injuries are caused by blasts. The physiology and pathology of blast injuries have been thoroughly studied. Human data for blast injuries is available and ready to use. However, there is no computational modeling tool to simulate the potential injuries. US Army Research laboratory at DEVCOM has developed a tool called "Operational Requirements-based Casualty Assessment (ORCA) Model" but it is not operational. The Defense Science and Technology Laboratories (Dstl) in UK also developed a tool called human injury predictor (HIP) but it is too simple to be applied to predict comprehensive injuries in the battle fields. In DTRA Reachback, we have received numerous requests from COCOMs to model the blast injuries in different scenarios. Because of the limitation of our current capability, we are not able to answer the questions and constantly disappoint the customers. It is therefore, urgent to develop a modeling tool or system to predict the blast injuries in order to support the warfighters. NATO has established a group to push this effort but the funding from NATO is very limited. We would like to make this proposal to send a signal to the acquisition community to be aware of this urgent request.

PHASE I: Phase I will focus on the model framework formation. Offerors should be able to understand the types of weapons, principle of the blasts, basic knowledge of human physiology and anatomy. Battle field or weapon testing experience is preferred. By the end of phase I, a GUI and premodel should be created and ready for next-step development. All the challenges should be clearly recorded in this phase in order to find solutions in the phase II.

PHASE II: Phase II will finish the construction work of the model. Data analysis, data input, testing and validation will be the major tasks in phase II. By the end of phase II, offerors should provide a package or system for the customers to use. The GUI will be further modified based on the end-user requests. The output should be validated by testing data and publication. The developer should work closely with DTRA Reachback personnel to test the system. Meanwhile, the developer should invite Command Surgeons and other medical staff to review the model to make sure that the model meets the military operational requirements.

PHASE III DUAL USE APPLICATIONS: In phase III, the offeror should refine the model based on the feedback from the Command Surgeons and other customers. The data need to be updated according to the newest research. Maintenance and update will be performed in phase III.

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REFERENCES:

1. Physics and Physiology Based Human Body Model of Blast Injury and Protection.https://www.sbir.gov/content/physics-and-physiology-based-human-body-model-blast-injury-and-protection-0;
2. A Human Body Model for Computational Assessment of Blast Injury and Protection.https://www.sbir.gov/node/401733;
3. Experimental platforms to study blast injury. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6581094/;
4. SIMULATING TRAUMATIC BRAIN INJURY IN VITRO: DEVELOPING HIGH THROUGHPUT MODELS TO TEST BIOMATERIAL BASED THERAPIES. https://blastinjuryresearch.health.mil/;
5. Simulation of blast lung injury induced by shock waves of five distances based on finite element modeling of a three-dimensional rat. https://www.nature.com/articles/s41598-019-40176-7;
6. Localizing Clinical Patterns of Blast Traumatic Brain Injury Through Computational Modeling and Simulation. https://www.frontiersin.org/articles/10.3389/fneur.2021.547655/full;
7. Computational modeling of human head under blast in confined and open spaces: primary blast injury. https://onlinelibrary.wiley.com/doi/full/10.1002/cnm.2590;
8. DOD-Funded Researcher Studies the Impact of Primary Blast Injuries on the Eye. https://www.eyeresearch.org/events/AEVR_Defense_Briefing_2013;
9. Numerical Simulation of Primary Blast Brain Injury. https://dukespace.lib.duke.edu/dspace/handle/10161/6148;
10. Protecting Warfighters from Blast Injury.https://www.cnas.org/publications/reports/protecting-warfighters-from-blast-injury;
11. Multi-scale Modeling of Trauma Injury. https://safe.menlosecurity.com/doc/docview/viewer/docN460C2D96D4A15f1662eabca807aa7063ed8351d624a6a3d835f7bdc24b841041cf7ee177d522;
12. Building and validating a model of human blast traumatic brain injury: a hybrid computational and experimental approach. https://safe.menlosecurity.com/doc/docview/viewer/docN460C2D96D4A1d83b1b981122f37e4529a40c914d71d1e784b944a6541cb33d665d92c1f4ed9a;
13. Framework for Modeling and Simulation of Human Lethality, Injury, and Impairment from Blast-Related Threats. https://safe.menlosecurity.com/doc/docview/viewer/docN460C2D96D4A1459dd86a43adab8605b2f9a3d0cbac0b6dcdedf7a66f4ec258c90faca9d99d31;
14. Understanding blast-induced neurotrauma: how far have we come? https://www.futuremedicine.com/doi/10.2217/cnc-2017-0006;
15. Review of blast injury prediction models .https://safe.menlosecurity.com/doc/docview/viewer/docN460C2D96D4A1bf203cc70ca924ff447610f6f6f86eaf5f1965f7031c3af1857e0c32f6790cea;
16. Blast Overpressure Induced Pulmonary and Intestinal Damage is Ameliorated by Post-injury Decay Accelerating Factor Injection. https://www.heraldopenaccess.us/openaccess/blast-overpressure-induced-pulmonary-and-intestinal-damage-is-ameliorated-by-post-injury-decay-accelerating-factor-injection;

KEYWORDS: Blast injuries; human medical treatment

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DTRA232-002 TITLE: Real-time Criticality Detection System for Field Operations

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Nuclear; Integrated Sensing and Cyber; Emerging Threat Requirements

OBJECTIVE: The Defense Threat Reduction Agency (DTRA) seeks technologies that can provide Department of Defense (DoD) personnel with the ability to pre-emptively identify and react to situations with potential nuclear criticality concerns. Events involving nuclear reactors or associated facilities and/or materials with unknown operating states (i.e. damage, configuration, or contamination) risk endangering DoD personnel who need to enter the facility or interact with the materials.

Since criticality events have exponential radiation effects, the introduction of additional moderating material, such as a human body, can lead to significant injury or loss of life. This topic is intended to provide additional capability to these response personnel with the following parameters:

(1) High confidence identification of environments requiring criticality safe operation(s) including in areas where contamination may be present

(2) Near real-time response – response and alarms, if necessary, in less than one minute of detector(s) on site

(3) Alarms and/or warning prior to a criticality accident occurring to allow personnel sufficient time to respond

(4) Mobile sensing – system should be reliant on sensors that are reasonably transportable by personnel

(5) Integration into a common operating picture system, such as TAK [1]

This solution should work in a variety of scenarios to range from an unknown contained material through a large, contaminated facility with a potential criticality concern. The majority of the work is expected to be focused on the algorithms, analyses, and data integration. Commercial off the Shelf (COTS) or Government off the shelf (GOTS) sensors should be used, though modifications are allowable if required for detection sensitivity or proper operation.

DESCRIPTION: Nuclear criticality safety is an extensively studied and implemented science in the industrial, regulatory, commercial, government, and academic spheres. The United States Nuclear Regulatory Commission [2] maintains requirements for criticality safety in operational facilities, and there are commercially available systems* for monitoring criticality safety, such as [3]. These systems and procedures are generally intended for controlled scenarios such as operating facilities or the transport of known quantities of materials.

In battlefield or emergency operations, however, the regular operation of procedures or systems may be disrupted, a team may be operating outside of a familiar environment, and/or facilities or materials may be encountered with uncertain states or histories. Furthermore, a team may be in a scenario where transport of large quantities of equipment is difficult or not feasible in a timely manner. These constraints make existing solutions not directly applicable to the DoD missions. There has been extensive progress made with respect to gamma and neutron detectors and the associated algorithms for detecting radioactive materials. This progress is also coupled with the development of data fusion and integration and visualization tools, which provides the potential of applying new science and analysis to this mission space.

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In this topic, DTRA is soliciting novel solutions for near real-time criticality detection to protect on-site personnel. Conceptual solutions may include both gamma and neutron sensing for dual mode criticality analysis, material and personnel localization, fission chain identification, distributed sensing, and/or other
approaches not yet considered. Solutions would ideally be portable and provide near real-time alarm capabilities. Ideal solutions will provide a level of mapping and localization in an eventual product and integrate in a common operating picture, such as TAK.

*This write-up mentions selected commercial products. Any and all products mentioned are for informational purposes only and are not an endorsement by DTRA, the DoD, or U.S. government.

PHASE I: Provide modeling and simulation to demonstrate how the proposed solution for real-time criticality analysis in an uncertain location will function across a range of scenarios, covering simple through complicated environments, with potential criticality concerns. Estimates of sensitivity, cost, required system load outs, and time for identification should be provided. The outcome of the Phase I will be a report summarizing the approach, concept of operations, expected detection capabilities, and uncertainties. A plan should also be included describing the Phase II efforts, how these efforts will meet requirements, and anticipated developmental risks with potential mitigations.

PHASE II: Demonstrate a laboratory-based physical solution for real-time criticality detection for a simplified problem space (i.e. an unknown mass and configuration of fissile material). At the end of Phase II a subset of the system should be operational and demonstrated to provide detection to benchmark results from the Phase I simulation. It is understood that actual fissile material tests may not be feasible at this stage of the development due to regulatory, safety, and security concerns, so an applicable simulated source or data inject will be considered acceptable. At the end of Phase II, it is expected, however, that if a realistic test were to be conducted the system would be in a Technology Readiness Level of 4 (Component and/or Breadboard Validation in a Laboratory Environment).

Refinements for more complicated scenarios including contamination and unknown environments should be considered.

PHASE III DUAL USE APPLICATIONS: Phase III will fully integrate the system and include networking into a common operating picture and provide alarming (both personnel and distributed)
capabilities. The system should be operational with potential for revision due to logistics and user input. At this stage a semi-realistic demonstration should be performed at an appropriate facility to simulate a realistic operation with end-user input. User and operational manuals should be provided and technical capabilities will be mostly complete.

REFERENCES:

1. https://tak.gov/
2. https://www.nrc.gov/
3. MIRION Technologies - CAAS-3S. https://www.mirion.com/products/criticality-accident-alarm-system

KEYWORDS: time sensing and visualization

VERSION 3

DTRA232-003 TITLE: ATAK Secure Routing Solution for CBRN Operations

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems

OBJECTIVE: DTRA seeks the development of a compact, ruggedized, all-in-one network routing solution for tactical use of the CBRN Plug-In within a local Android Team Awareness Kit (ATAK) Server that is compatible with the existing MANET radios currently employed by OI-CO and SOCOM. For DTRA, this will enable Technical Support Groups (TSGs) to utilize the ATAK CBRN Plug-in (CBRNPI) locally in any operational environment regardless of the communications restrictions present in the specific area of responsibility. Further commercialization is envisioned to provide benefit to other Federal Government agencies and to State and Local Governments for needs such as law enforcement and search and rescue.

DESCRIPTION: TSG's are tasked with providing Geographic Combatant Commanders (GCC) with the capability of real-time detection, location, identification, and characterization of CBRN materials of concern. CBRN search operations are often conducted in complex environments that greatly limit standard wireless network connections. Software defined radios that utilize Mobile Ad-hoc Networks (MANET) technology are able to self-heal and scale in number with minimal data throughput degradation even in GPS denied environments. When paired with MANET radios, a local ATAK server with powerful processing capabilities allows operators to fully utilize the ATAK CBRNPI and capture all real-time sensor data regardless of communication restrictions over common networks (e.g., LTE, SATCOM). Integrating both the MANET radio and ATAK server into a router allows operators the option of using both global SIM cards and military SATCOM in a portable package that meets the dismounted SWaP requirements of the TSG's CBRN mission. Currently, no singular government or commercial product exists to conduct edge computing and tactical network routing while also providing a local ATAK server capable of storing historic data from a potentially large number of simultaneously streaming sensors, running individual search and ID algorithms.

Requirements for this development are as follows:

- Router
    - Dual-SIM, Dual-Modem with active fail-over protection
    - 2.4 and 5 GHz with WiFi 6 support
    - 2 x LAN and 1xWAN Ethernet Ports
    - Capable or running an internal VPN
    - Internal LTE antennas
- MANET Radio
    - 6-Watt transmission power with 3x3 MIMO and 120 Mb/s of data throughput
    - L, S, and C band capable with interchangeable modules
    - AES 256 encryption
    - RNDIS ports capable of routing IP traffic
    - Web accessible GUI for specific radio configurations
- ATAK Server
    - Quad core I7 processor
    - 32 GB DDR4 RAM
    - 1TB SSD
    - x86 (not ARM) compatible with Linux based OS interoperable with ATAK Server requirements
    - No cooling required
- SWaP:

- o Approximate dimension of final packaging must be less than 5" x 5" x 3"
- o Less than 3 lbs in weight
- o Capable of running off of both a standard military 2590 or 2557 Lithium battery and 120/240 VAC (power source should not be included in dimension and weight requirements)
- o Capable of swapping batteries with no loss of configured router, radio, or server settings
- o IP Rating of no less than IP44
- o Internal LTE antennas
- o 3 x flexible radio antennas with horizontal and vertical polarization

- User Interface – centralized location that displays the following:
  - o Static IP addresses for the LAN, MANET radio, and ATAK Server
  - o Current VPN status
  - o Hyperlink to MANET radio GUI
  - o Current SIM/s status

PHASE I: ATAK Router development will start with the performer conducting thorough market research of the individual COTS and GOTS solutions that are currently available and meet the above requirements of each component/subcomponent. Once the correct COTS/GOTS solutions are identified, a lab bench style integration will be conducted followed by a live demonstration that validates the the propoased approach while establishing the feasibility of the chosen configuration of integrated components. The demonstration will result in a relavant display of data in the ATAK CBRNI. Further refinement will focus on modification/replacement of the individual components to better meet SWaP and User Interface requirements. Phase 1 should culminate with two protoypes that successfully demonstrate the ability to meet the requirements listed in the Desription Section.

PHASE II: This portion of development should focus on system refinements, such as to SWaP, and refining the GUI to meet requirments. An additiononal focus should be on the development of a commercially available kit that includes user cables, manuals, user training curriculum, and outer storage packaging of the now COTS ATAK Router. The final deliverable will be six ATAK Router Kits with an intended focus towards SOCOM users.

PHASE III DUAL USE APPLICATIONS: No entry

REFERENCES:

1. An Overview of MANET Technologies – Finabel, (https://finabel.org/wp-content/uploads/2022/10/48.-An-Overview-of-MANET-Technologies-Advantages-and-Disadvantages-in-the-Military.pdf);
2. ATAK Product Center, (https://atak.gov);
3. Arnhouse Digital Device Corporation - ADDC, (https://addc.com/product/biodigitalpc-12x/);
4. Comparing Dual SIM vs Dual Modem – CradlePoint, (https://cradlepoint.com/resources/blog/comparing-dual-sims-vs-dual-modems/);
5. What is Wifi 6? – Intel, (https://www.intel.com/content/www/us/en/gaming/resources/wifi-6.html);
6. BB-2590/U, 9.9 AH – BrenTronics, (https://www.bren-tronics.com/bt-70791cg.html);

KEYWORDS: Tactical Edge Computing; ATAK; CBRN Search; IoT; Software Defined Tactical Mesh Radio; Single Board Computers

VERSION 3

DTRA232-004 TITLE: A Portable Hardware Solution for Real-Time DNA and RNA Sequencing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Biotechnology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: DTRA seeks to develop a US-based, portable, open-architecture tablet designed for SOCOM ATAK users that is capable of visualizing and conducting real-time DNA or RNA sequencing in a tactical environment. Further commercialization is envisioned to provide benefit to other government users of the ATAK situational awareness environment by providing real-time~~, presumptive~~ DNA or RNA sequencing with field awareness to decision makers.

DESCRIPTION: Biological Warfare Agent (BWA) detection and identification options for SOCOM users are limited in both available technologies and scope of the ID capaility ~~and library size~~. Lab-based theater confirmatory DNA and RNA sequencing are possible, but not technically or tactically feasible for SOCOM operators at this time. Additionally, the methods employed by operators, Hand Held Assay ~~Hereditary Hemolytic Anemia~~ (HHA) and Polymerase Chain Reaction-based (PCR) tools, are definitively limited to known and specifically targeted BWAs ~~by their BWA library sizes~~. Sequencing, however, is capable of having a BWA library that is only limited by available processing power and available genomic data ~~and hard drive space~~. The specific need for SOCOM users is a stand-alone tablet capable of targeting low complexity, high biomass BWA samples in a time-constrained tactical environment. When combined with the ATAK CBRN Plug-in (CBRNPI), on-target sequencing results will be viewable in real-time by CONUS/OCONUS laboratories, and decision-makers at the Joint Operations Center (JOC). Applying ATAK to this sequencing effort prevents potential sampling errors by employed operators, and also drastically reduces the decision-making timeline by providing near real-time results.

Requirements for this development are as follows:

- Tablet SWaP:
  - Utilizes Nanopore Technology 512 Channel MinION Flow Cell ~~and Flongle~~
  - LED touch screen, approximate dimensions 6” x 4”
  - Approximate overall dimensions, 6.5” x 6” x 1”
  - Weight = <2.0 lbs
  - 1 x GB Ethernet LAN port
  - 1 x Thunderbolt 4 USB-C connection
  - Powered by Mil Spec-2590 lithium battery or 120/240 VAC
  - Micro SD Card slot with 1TB support
  - Tablet is Static IP and DHCP Configurable
  - Capable of emitting Wifi 6 to make a wireless connection to an android end user device ~~phone~~
- Minimum Computational Requirements
  - Quad Core I7, 8th Gen or newer
  - 32 GB DDR4 RAM

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- o x86 capable of running Linux-based OS
- o 1 TB SSD
- o No additional cooling required
- o Hot-swappable server blade
- • ATAK Integration
- o Integration into the ATAK CBRNPI utilizing ProtoBuff programming language partnered with a DTRA-approved ATAK CBRNPI Developer

PHASE I: Begin with a market research study of potential COTS hardware solutions that meet SWaP requirements. Demonstrate the feasibility of integrating and confirming the compatibility of a processor unit to the Nanopore Technologies (NPT) MinION in such a way that would result in a small form factor as described in the requirements. Additionally, start development of the sequencing software GUI. Also, demonstrate the feasibility of connecting this integrated unit to an Android based end user device. Integrate a BWA library into the sequencer's computer in coordination with the DTRA project team. Conduct successful benchtop functionality test consisting of a standalone computer for visualization, sequencing computer, MinION reader, and pre-prepared reagent sample. Culminate Phase 1 with a digital rendering of a tablet prototype to include a conceptual engineering breakdown of the components and software that is physically capable of integrating the NPT MinION flow cells utilizing respective COTS hardware components to meet the outlined requirements.
~~Start development of the sequencing software GUI utilizing the identified small form factor computer for processing but visualized using a separate computer. Integrate and confirm the compatibility of the stand-alone Nanopore Technologies MinIon. Integrate the DTRA OI-CO BWA library into the sequencer's computer. Conduct successful benchtop functionality test consisting of a standalone computer for visualization, sequencing computer, MinIon reader, and pre-prepared reagent sample. Culminate Phase 1 with a digital rendering of a tablet prototype that is physically capable of integrating either the NPT MinION or Flongle flow cells utilizing respective COTS hardware component that meets the outlined requirements.~~

PHASE II: Focus on building, testing, and refining with an integrated initial prototype ~~the 3D-printed prototype~~. After full functionality is achieved with the prototype, begin integration of the sequencer into the ATAK CBRNPI. Post ATAK integration, the prototype sequencer will need to conduct a successful benchtop test while also being remotely viewable within ATAK. Pending a successful functionality test, a minimum of two fully functional sequencers will need to be created with a final packaging of either machined aluminum or injection-molded polymer that meets all final SWaP requirements. Discussion will occur with the DTRA program team about future integration into a fully equipped sequencing kit. DTRA seeks an end state that results in a single device that can run the MinION, utilize the MinION software (MinKNOW) to catalogue data, and feed the raw data streaming from the MinKNOW into a GUI connected to the ATAK CBRNPI. ~~The remaining portion of Phase II should focus on designing and creating two fully equipped sequencing kits that can be utilized for additional user testing. The culmination of this phase should include identifying a future manufacturer and cost for sequencing kits.~~

PHASE III DUAL USE APPLICATIONS: No entry

REFERENCES:

1. Nanopore Technologies, MinION -https://nanoporetech.com/products/minion;
2. Handheld Genomic Sequencer Shows Promise in Field Demo - https://www.army.mil/article/209780/handheld_genomic_sequencer_shows_promise_in_field_demo;

3. Sequencer for soldiers: battlefield genomics -https://nanoporetech.com/resource-centre/sequencers-soldiers-battlefield-genomics-0;
4. Arnhouse Digital Devices Corporation, BioDigital PC12X -https://addc.com/product/biodigitalpc-12x/;

KEYWORDS: Biosequencing; Portable Genomic Sequencing; ATAK Situational Awareness; Edge Computing

VERSION 3

DTRA232-005 TITLE: Field Calibration of Standoff, Ground-Based Hyperspectral Imaging Sensors Used for Vapor Mass Quantification of Plumes

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): General Warfighting Requirements (GWR); Emerging Threat Requirements

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Collateral effects predictions are a major consideration for decision-makers when planning counter weapons of mass destruction (C-WMD) operations as unintentional releases of WMD materials can harm non-combatants and have significant strategic implications. In order to study the effectiveness of C-WMD technologies and tactics, researchers use standoff, ground-based long wave infrared (LWIR) hyperspectral imaging (HSI) to quantify the vapor mass of specific chemicals in plumes resulting from explosive-driven test events. The vapor mass quantification measurements are particularly sensitive to the difference in temperature between the plume and the background, which could include some combination of bare-earth, vegetation, blue-sky, and/or clouds. The objective of this topic is to develop a method for calibrating HSI systems for vapor mass quantification of plumes with different backgrounds to increase measurement accuracy and provide estimates of measurement uncertainty.

DESCRIPTION: The use of LWIR HSI for standoff vapor mass quantification of plumes has proven very useful for evaluating the ability of C-WMD technologies and tactics to minimize unintentional chemical releases and the associated collateral effects. Thorough field calibration of these systems, including the ability to adjust measurements for different environmental and background conditions, has proven difficult.

The near term simulant of interest is Diisopropyl methylphosphonate (DIMP), which is generally disseminated as a fine aerosol and must evaporate before HSI vapor mass measurements can occur. At the same time the fringes of the plume are diffusing and dropping below the HSI pixel detection threshold. This means we will always have less than 100% recovery for an artificial plume with a known mass. A system or method enabling the quantification of HSI capabilities as a function of both chemical mass and thermal background is desired. Required vapor masses range from 10s of grams to 10s of kilograms, and the absolute differential between ambient and background thermal backgrounds in the LWIR range from 1° C to 15° C.

To-date, artificially generated plumes from a ground-based disseminator have provided limited calibration data, however, the system relied on evaporation of fine aerosols, requiring long spray durations to achieve desired vapor masses and total mass quantification was limited by environmental diffusion effects. Further, the ground-based dissemination system was limited to highly variable thermal backgrounds, e.g., mix of background terrain, horizon, and sky background, and therefore unable to develop calibration curves as a function of thermal background conditions.

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Development of an unmanned-aerial-system (UAS) disseminator to release an in-scene reference plume with known vapor mass and sky background would overcome some of the limitations of the ground-based system. Other approaches are also of interest and encouraged for this solicitation.

PHASE I: Demonstrate concepts to calibrate an HSI system by generating well-characterized in-scene reference plumes or other calibration targets. Demonstrate that the system could be used to study the effects of different backgrounds, plume heights, and/or temperature differentials. A plan should also be submitted outlining the approach for scaling the system to meet Phase II requirements.

PHASE II: Demonstrate the ability of the system to perform HSI calibration and account for the parameters of interest. Systems that generate in-scene reference plumes should be capable of using DIMP or other common simulant materials. All data collected during the demonstration and analysis of the system will be included in the final report along with a user's manual and a data package on all critical system components. Hardware developed will also be delivered to the government.

PHASE III DUAL USE APPLICATIONS: Phase III will demonstrate and deliver a complete HSI calibration system capable of accounting for all the parameters of interest. Commercialization strategies will depend heavily on the approach chosen but at a minimum will include sales of systems/services to scientific and commercial users of HSI.

REFERENCES:

1. Gallagher, Neal & Wise, Barry & Sheen, David. (2003). Estimation of trace vapor concentration-pathlength in plumes for remote sensing applications from hyperspectral images. Analytica Chimica Acta. 490. 139-152. 10.1016/S0003-2670(03)00177-6.
2. Gallagher, Neal & Wise, Barry & Sheen, David. (2003). Error Analysis for Estimation of Trace Vapor Concentration Pathlength in Stack Plumes. Applied spectroscopy. 57. 614-21. 10.1366/000370203322005283.
3. Hall, Jeffrey & Boucher, Richard & Buckland, Kerry & Gutierrez, David & Keim, Eric & Tratt, David & Warren, David. (2016). Mako airborne thermal infrared imaging spectrometer: performance update. Proc. SPIE 9976, Imaging Spectrometry XXI, 997604.
4. Ifarraguerri, Agustin & Ben-David, Avishai. (2008). Impact of atmospheric boundary layer turbulent temperature fluctuations on remote detection of vapors by passive infrared spectroscopy. Optics express. 16. 17366-82. 10.1364/OE.16.017366.
5. Sheen, David & Gallagher, Neal & Sharpe, Steven & Anderson, Kevin & Schultz, John & Shen, Sylvia & Lewis, Paul. (2003). Impact of background and atmospheric variability on infrared hyperspectral chemical detection sensitivity. Proceedings of SPIE - The International Society for Optical Engineering. 5093. 10.1117/12.488931.
6. Young, S.J.. (2023). Detection and Quantification of Gases in Industrial-stack Plumes Using Thermal Infrared Hyperspectral Imaging.

KEYWORDS: Sensor; modeling; plume; UAS; dispersion; CBRN; weapons; simulant

VERSION 3

DTRA232-006 TITLE: Standoff Aerosol Plume Density and Particle Size Quantification

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): General Warfighting Requirements (GWR); Emerging Threat Reduction

OBJECTIVE: The objective of this effort is to develop, calibrate, verify and validate a standoff ground-based optical system capable of measuring aerosol plume density and particle size distribution.

DESCRIPTION: In order to quantify the inadvertent release of hazardous material associated with the destruction of threat chemical and biological facilities, DTRA seeks to develop a capability to remotely sense aerosol plume density and particle size distribution.

Past efforts to quantify aerosol plumes have used hyperspectral imaging, single-color LIDAR, and other similar technologies. While these technologies have been used to assess plume densities, they are ill-suited to measuring particle size distribution. Quantification of both variables is essential to assessing the total potential exposure to a local population as well as to estimating how far a plume is expected to propagate in the environment.

Currently, the only technique available to accurately quantify aerosol plume parameters [1] is the placement of point sensors within the envelop of a plume. However, this technique cannot be applied in most operational environments. Prior published work [2-6] has shown that some optical systems may provide the ability to estimate particle size distribution.

The phase III end state of this work is to deliver an optical system to the warfighter that provides a standoff ground-based optical sensor capable of measuring aerosol plume density and particle size distribution. It should be able to measure particles in the 2-40 micron range, operate at a stand-off distance of 300 m to 3 km, and be eye safe (preferred but not required).

PHASE I: Demonstrate the concept in a controlled laboratory or similar environment, identifying limits of detection related to aerosol particle sizes, aerosol concentrations, and stand-off distances. Ideally, at this scale, generating a well-characterized aerosol environment in an aerosol chamber that can achieve a steady-state condition is conducive to quantification of aerosol concentration and particle size distribution with verification and validation using several aerosol particle size and concentration point sensors inside of the aerosol chamber. The optical diagnostic capability could sample the aerosol chamber contents through opening shutters. Verification and validation should also include testing with both wet and dry aerosol particles, as well as testing under day and night time lighting conditions. The goal is to have a statistical confidence of >90% for aerosol concentration and particle size distribution demonstrated under the steady-state aerosol conditions in a controlled environment.

PHASE II: 1) Develop an initial prototype system capable of operating in a field environment. 2) In an open-air controlled test, validate quantification capability against a well-characterized aerosol source by statistically determining the level of agreement with a point source ground truth sensor and having a goal of obtaining statistical confidence of >90% for aerosol concentration and particle size distribution. Quantification efforts should include comparisons within an identified aerosol region where theoretical concentrations and particle size distributions can be verified with aerosol concentration and particle size point sensors. This open air controlled aerosol region could be within a plume Taylor Cone or a Steady State regime. Several different concentrations and distances should be selected in this validation effort, to compare to the limits of detection defined in Phase I testing. Later phases of open air testing should introduce wind effects.

PHASE III DUAL USE APPLICATIONS: 1) Deliver a final prototype 2) Integrated Aerosol and Vapor Applications: Validate and Verify quantitation efforts, including a full-scale test, with a DoD, DoE Laboratory or commercial partner to integrate aerosol data with Hyperspectral Imaging data sets to account for total plume mass quantification.

REFERENCES:

1. Kovalev, V. Eichinger, W. (2004) Elastic Lidar: Theory, Practice and Analysis Methods. Wiley Warren, Russell & Vanderbeek, Richard & Ben-David, Avishai & Ahl, Jeffrey. (2008). Simultaneous estimation of aerosol cloud concentration and spectral backscatter from multiple-wavelength lidar data. Applied optics. 47. 4309-20. 10.1364/AO.47.004309.
2. Marchant, Christian. (2010) Retrieval of aerosol mass concentration from elastic lidar data. PhD Dissertation in Electrical Engineering, Utah State University, Logan, UT
3. Huige, Di & Wang, Qiyu & Hangbo, Hua & Li, Siwen & Yan, Qing & Liu, Jingjing & Song, Yuehui & Hua, Dengxin. (2018). Aerosol Microphysical Particle Parameter Inversion and Error Analysis Based on Remote Sensing Data. Remote Sensing. 10. 1753. 10.3390/rs10111753.
4. Jagodnicka, Anna & Stacewicz, Tadeusz & Karasiński, Grzegorz & Posyniak, Michał & Malinowski, Szymon. (2009). Particle size distribution retrieval from multiwavelength lidar signals for droplet aerosol. Applied Optics. 48. B8.
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KEYWORDS: Lasers; Spectroscopy; Weapons; CWMD; Aerosol Plume; Agent Defeat; Optics