MISSILE DEFENSE AGENCY (MDA)
15.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Missile Defense Agency's (MDA) mission is to develop, test, and field an integrated, layered, Ballistic Missile Defense System (BMDS) to defend the United States, its deployed forces, allies, and friends against all ranges of enemy ballistic missiles in all phases of flight.

The MDA Small Business Innovation Research (SBIR) Program is implemented, administrated, and managed by the MDA SBIR/STTR Program Management Office (PMO), located within the Advanced Technology (DV) Directorate. Specific questions pertaining to the MDA SBIR Program should be submitted to:

Missile Defense Agency
SBIR/STTR Program Office
MDA/DVR
Bldg 5222, Martin Road
Redstone Arsenal, AL 35898

Email: sbirsttr@mda.mil
Phone: 256-955-2020

Proposals not conforming to the terms of this Solicitation will not be considered. MDA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality will be funded. Only Government personnel will evaluate proposals.

Please read the entire DoD solicitation and MDA instructions carefully prior to submitting your proposal. Please download and review the SBIR Policy Directive issued by the Small Business Administration.

Federally Funded Research and Development Centers (FFRDCs) and Support Contractors

The offeror's attention is directed to the fact that non-Government advisors to the Government may review and provide support in proposal evaluations during source selection. Non-government advisors may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. These advisors will not establish final assessments of risk and will not rate or rank offeror's proposals. They are also expressly prohibited from competing for MDA SBIR or STTR awards in the SBIR/STTR topics they review and/or on which they provide comments to the Government.

All advisors are required to comply with procurement integrity laws. Non-Government technical consultants/experts will not have access to proposals that are labeled by their proposers as "Government Only." Pursuant to FAR 9.505-4, the MDA contracts with these organizations include a clause which requires them to (1) protect the offerors' information from unauthorized use or disclosure for as long as it remains proprietary and (2) refrain from using the information for any purpose other than that for which it was furnished. In addition, MDA requires the employees of those support contractors that provide technical analysis to the SBIR/STTR Program to execute non-disclosure agreements. These agreements will remain on file with the MDA SBIR/STTR PMO.

Non-Government advisors will be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to perform their respective duties. In accomplishing their duties related to the source selection process, employees of the aforementioned organizations may require access to proprietary information contained in the offerors' proposals.

OFFEROR SMALL BUSINESS ELIGIBILITY REQUIREMENTS

Each offeror must qualify as a small business at time of award per SBA's regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Additionally, in accordance with the Small Business Administration's (SBA) SBIR Program Policy Directive dated 24 February 2014 offerors must re-certify at certain points during the Phase I and Phase II period of performance to ensure that the awardee is in compliance with the program's requirements.

SBA Company Registry

Per the SBIR Policy Directive, all SBIR applicants are required to register their firm at SBA's Company Registry prior to submitting an application. Upon registering, each firm will receive a unique control ID to be used for submissions at any of the 11 participating agencies in the SBIR or STTR programs. For more information, please visit the SBA's Firm Registration Page: http://www.sbir.gov/registration.

ORGANIZATIONAL CONFLICTS OF INTEREST

Contract awards to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees which may be a violation of federal law. Proposing firms should contact the MDA SBIR/STTR PMO for further guidance if in this situation.

The basic rules are covered in FAR 9.5 as follows (the Contractor is responsible for compliance):

(1) the Contractor's objectivity and judgment are not biased because of its present or planned interests which relate to work under this contract;

(2) the Contractor does not obtain unfair competitive advantage by virtue of its access to non-public information regarding the Government's program plans and actual or anticipated resources; and

(3) the Contractor does not obtain unfair competitive advantage by virtue of its access to proprietary information belonging to others.

All other applicable rules under the FAR Section 9.5 apply to Contractors.

USE OF FOREIGN NATIONALS

See the "Foreign Nationals" section 3.5 of the DoD SBIR Program Solicitation Instructions for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals MUST disclose this information regardless of whether the topic is subject to export control restrictions. 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. You may be asked to provide additional information 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)).

Proposals submitted with a foreign national listed will be subject to security review during the contract negotiation process (if selected for award). If the security review disqualifies a foreign national from participating in the proposed work, the contractor may propose a suitable replacement. In the event a proposed foreign person is found ineligible to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale.

EXPORT CONTROL REGULATIONS (ITAR/EAR)

The technology within some MDA 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. You must ensure that your firm complies with all applicable export control regulations. Please refer to the following URLs for additional information: http://www.pmddtc.state.gov/regulations_laws/itar.html and http://www.bis.doc.gov/index.php/.

Proposals submitted to export control-restricted topics will be subject to security review during the contract negotiation process (if selected for award). In the event a firm is found ineligible to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale.

CLAUSE H-08 PUBLIC RELEASE OF INFORMATION (Publication Approval)

Clause H-08 pertaining to the public release of information is incorporated into all MDA SBIR and STTR contracts. All materials which relate to work performed by the contractor under MDA SBIR and STTR contracts must be submitted to MDA for review and approval prior to release to the public. Subcontractor public information materials must be submitted for approval through the prime contractor to MDA.

FRAUD, WASTE, AND ABUSE

To Report Fraud, Waste, or Abuse, Please Contact:

MDA Fraud, Waste & Abuse
Hotline: 256-313-9699
MDAHotline@mda.mil

DoD Inspector General (IG) Fraud, Waste & Abuse
Hotline: 800-424-9098
hotline@dodig.mil

Additional information on Fraud, Waste and Abuse may be found in the DoD Instructions of this solicitation; Sections 3.6 and 4.19.

PROPOSAL FUNDAMENTALS

Proposal Submission

All proposals MUST be submitted online using the DoD SBIR/STTR submission system at https://sbir.defensebusiness.org/. Any questions pertaining to the DoD SBIR/STTR submission system should be directed to the DoD SBIR/STTR Help Desk: 1-800-348-0787.

Classified Proposals

Classified proposals **are not** accepted under the MDA SBIR/STTR Program. Contractors currently working under a classified MDA SBIR/STTR contract must use the security classification guidance provided under that contract to verify new SBIR/STTR proposals are unclassified prior to submission. Phase I contracts are not typically awarded for classified work. However, in some instances, work being performed on Phase II proposals will require security clearances. If a Phase II contract will require classified work, the proposing firm must have a facility clearance and appropriate personnel clearances in order to perform the classified work. For more information on facility and personnel clearance procedures and requirements, please visit the Defense Security Service Web site at: http://www.dss.mil/index.html.

Communication

All communication from the MDA SBIR/STTR PMO will originate from the sbirsttr@mda.mil email address. Please white-list this address in your company's spam filters to ensure timely receipt of communications from our office.

Proposal Status

The MDA SBIR/STTR PMO will distribute selection and non-selection email notices to all firms who submit a MDA SBIR/STTR proposal. The email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet. MDA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission.

Debriefing

MDA offers debriefings to unsuccessful offerors in accordance with Federal Acquisition Regulation (FAR) Subpart 15.5. Requests for debriefing must be submitted in writing to the MDA SBIR/STTR PMO within 30 calendar days of non-selection notification. Non-selection notifications will provide instructions for requesting a proposal debriefing.

Discretionary Technical Assistance (DTA)

Section 9(b) of the SBIR and STTR Policy Directives allows agencies to enter into agreements with vendors to provide technical assistance to SBIR or STTR awardees, which may include 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.

The purpose of this technical assistance is to assist SBIR or STTR awardees in:

- Making better technical decisions on SBIR projects
- Solving technical problems that arise during SBIR projects;
- Minimizing technical risks associated with SBIR projects; and
- Commercializing the SBIR product or process.

MDA permits award recipients to obtain technical assistance in accordance with the SBIR and STTR Policy Directives. Alternatively, an SBIR or STTR firm may acquire the technical assistance services described above on its own. Firms must request this authority from MDA and demonstrate in its SBIR or STTR proposal that the individual or entity selected can provide the specific technical services needed. In addition, costs must be included in the cost volume of the offeror's proposal. The DTA provider may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner or research institution).

If the awardee demonstrates this requirement sufficiently, MDA will permit the awardee to acquire such technical assistance itself, in an amount up to $5,000, as an allowable cost of the SBIR or STTR award. The per year amount will be in addition to the award and is not subject to any profit or fee by the requesting firm and is inclusive of all indirect rates. The per-year amount is based on the original contract period of performance and does not apply to period of performance extensions. Requests for DTA funding outside of the Phase I or Phase II proposal submission will not be considered.

PHASE I PROPOSAL GUIDELINES

The DoD SBIR/STTR Proposal Submission system (available at https://sbir.defensebusiness.org/) will lead you through the preparation and submission of your proposal. Read the front section of the DoD solicitation for detailed instructions on proposal format and program requirements. Proposals not conforming to the terms of this solicitation will not be considered.

MAXIMUM PHASE I PAGE LIMIT FOR MDA IS 20 PAGES

Any pages submitted beyond the 20-page limit within the Technical Volume (Volume 2) will not be evaluated. **Your Proposal Cover Sheet (Volume 1), Cost Volume (Volume 3), and Company Commercialization Report (Volume 4) DO NOT count toward your maximum page limit.**

Phase I Proposal

A complete Phase I proposal consists of four volumes:

- Volume 1: Proposal Cover Sheet
- Volume 2: Technical Volume
- Volume 3: Cost Volume
- Volume 4: Company Commercialization Report

MDA intends for the Phase I effort to determine the merit and technical feasibility of the concept. The contract period of performance for Phase I shall be six (6) months and the award shall not exceed $100,000. A Phase I Option may be submitted with a period of performance of 6 months and an amount not to exceed $40,000. A list of topics currently eligible for proposal submission is included below, followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time.

References to Hardware, Computer Software, or Technical Data

In accordance with the SBIR Directive, SBIR contracts are to conduct feasibility-related experimental or theoretical R/R&D related to described agency requirements. The object of the Phase I is to determine the scientific and technical merit and feasibility of the proposed effort and quality of performance of the Small Business Concern. It is not for formal end-item contract delivery, and ownership by the Government of your hardware, computer software, or technical data.

Based on this, in your technical proposal, do not use the term "Deliverables" when referring to your hardware, computer software, or technical data. Instead use the term: “Products for Government Testing, Evaluation, and/or Demonstration.”

The standard formal deliverables for a Phase I are the Report of Invention and Disclosure, Midterm Status Report, Certificates of Compliance, Computer Software Product (normally not applicable for a Phase I), Prototype Design and Operation Document (normally not applicable for a Phase I), and the Final Report.

PHASE I PROPOSAL SUBMISSION CHECKLIST

All of the following criteria must be met or your proposal will be REJECTED.

____1. **The following have been submitted electronically through the DoD submission site by 6:00 a.m. (EDT) 24 June 2015.**

_____ a. Volume 1: DoD Proposal Cover Sheet

_____ b. Volume 2: Technical Volume (DOES NOT EXCEED 20 PAGES): **Any pages submitted beyond this will not be evaluated. Your Proposal Cover Sheet, Cost Volume, and Company Commercialization Report DO NOT count toward your maximum page limit.**

_____ c. **If proposing to use foreign nationals; identify the foreign national(s) you expect to be involved on this project, the type of visa or work permit under which they are performing, country of origin and level of involvement.**

_____ d. Volume 3: Cost Volume. (**Online Cost Volume form is REQUIRED by MDA.**)

_____ e. Volume 4: Company Commercialization Report. (Required even if your firm has no prior SBIRs.)

____2. The Phase I proposed cost plus option does not exceed $140,000.

____3. Your firm must be registered with SBA’s Company Registry.

PHASE I OPTION MUST BE INCLUDED AS PART OF PHASE I PROPOSAL

MDA implements the use of a Phase I Option that may be exercised at MDA’s sole discretion to fund interim Phase I activities while a Phase II contract is being negotiated. Only Phase I efforts selected for Phase II awards through MDA’s competitive process will be eligible to have the Phase I Option exercised. The Phase I Option, which must be included as part of the Phase I proposal, should cover activities over a period of up to six months and describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option must be included within the 20-page limit for the Phase I proposal.

Proposal titles, abstracts, anticipated benefits, and keywords of proposals that are selected for contract award will undergo an MDA Policy and Security Review. Proposal titles, abstracts, anticipated benefits, and keywords are subject to revision and/or redaction by MDA. Final approved versions of proposal titles, abstracts, anticipated benefits, and keywords will appear on the DoD SBIR/STTR awards website at https://sbir.defensebusiness.org/.

MDA PROPOSAL EVALUATIONS

MDA will evaluate and select Phase I and Phase II proposals using scientific review criteria based upon technical merit and other criteria as discussed in this solicitation document. MDA reserves the right to award none, one, or more than one contract under any topic. MDA is not responsible for any money expended by the proposer before award of any contract. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

MDA Phase I and Phase II proposals will be evaluated based on the criteria outlined below, including potential benefit to the Ballistic Missile Defense System (BMDS). Selections will be based on best value to the Government considering the following factors which are listed in descending order of importance:

a) The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
b) The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
c) The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

In Phase I and Phase II, firms with a Commercialization Achievement Index (CAI) at or below the 20th percentile will be penalized in accordance with the DoD program solicitation.

Please note that potential benefit to the BMDS will be considered throughout all the evaluation criteria and in the best value trade-off analysis. When combined, the stated evaluation criteria are significantly more important than cost or price.

It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Technical reviewers will base their conclusions on information contained in the proposal. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be contained in the proposal and will count toward the applicable page limit.

Qualified advocacy letter(s) will count towards the proposal page limit and will be evaluated towards criterion C. Advocacy letters are not required for Phase I or Phase II.

A qualified advocacy letter is from a relevant commercial or Government Agency procuring organization(s) working with MDA, articulating their pull for the technology (i.e., what BMDS need(s) the technology supports and why it is important to fund it), and possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program. This letter should be included as the last page(s) of your technical upload. Advocacy letter(s) which are faxed or e-mailed separately will NOT be considered.

Phase II Proposal Submission

Per DoD SBIR Phase II Proposal guidance, all Phase I awardees from the 15.2 Phase I solicitation will be permitted to submit a Phase II proposal for evaluation and potential award selection. Details on the due date, content, and submission requirements of the Phase II proposal will be provided by the MDA SBIR/STTR Program Management Office either in the Phase I award contract or by subsequent notification. Only firms who receive a Phase I award resulting from the 15.2 solicitation may submit a Phase II proposal. The one and only time that Phase II proposals based on the 15.2 Phase I awards may be submitted is during this 15.2 Phase II solicitation window.

MDA will evaluate and select Phase II proposals using the Phase II evaluation criteria listed in the DoD Program Solicitation. While funding must be based upon the results of work performed under a Phase I award and the scientific and technical merit, feasibility and commercial potential of the Phase II proposal; Phase I final reports will not be reviewed as part of the Phase II evaluation process. The Phase II proposal should include a concise summary of the Phase I effort including the specific technical problem or opportunity addressed and its importance, the objective of the Phase I effort, the type of research conducted, findings or results of this research, and technical feasibility of the proposed technology. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. MDA does NOT participate in the DoD Fast Track program.

All Phase II awardees must have a Defense Contract Audit Agency (DCAA) approved accounting system. It is recommended that an approved accounting system be in place prior to the MDA Phase II award timeframe. If you do not have a DCAA approved accounting system, this will delay / prevent Phase II contract award.

MDA SBIR 15.2 Topic Index

MDA SBIR 15.2 Topic Index by Research Area

DP-GMD (GM)

MDA15-023 Solid State High Power Amplifier for Communications

QS-Quality, Safety & Mission Assurance (QS)

MDA15-024 Non-Destructive Testing Methods for Detecting Red Plague Within an Insulated Silver Plated Copper Conductor

MDA15-025 Passive Inter-Modulation RF Emissions Utilized for Identifying Galvanic Corrosion in Metal Structures

MDA SBIR 15.2 Topic Descriptions

MDA15-001 TITLE: Advanced Cognition Processing and Algorithms for Improved Identification

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Elicit innovative concepts and techniques to develop target recognition approaches focused on cognitive synthesis of current and emerging sensor data sources. As techniques are developed and examined to reduce the reliance on prior measurements, they could potentially be incorporated into a classification algorithm, feature, or as a post-processing step. This research effort could increase resilience of features and robustness of classifiers.

DESCRIPTION: Fixed measurements, features, and classifiers preclude systems from changing decision logic based on new information collected during an engagement, since tactical operational environments are often different from those used to collect or generate sample data. This potentially causes sensor bias thus ultimately impacts object classification. In addition, the sample data may vary form the actual data of interest. Because the measurements, features, and classifiers are fixed, traditional techniques do not allow systems to adapt to new information and change the decision based on this new information. The next evolution of target recognition approaches need to be less sample-driven and should focus on cognitive synthesis of disparate information sources. The selected innovative approach should incorporate not just classifiers, but should also consider learning techniques to blend logical inference, deductive reasoning, and expert knowledge systems. Techniques should not rely primarily on estimated sample points with fixed priors, but can employ physics, game theory, and knowledge engineering based on intelligence understanding.

PHASE I: Develop a proof of concept design/study. Identify designs/models, and conduct a feasibility assessment for the proposed algorithm, model, technique, and/or methods. Work should clearly validate the viability of the proposed solution with a clear concept-of-operation document.

PHASE II: Based on the results and findings of Phase I, develop and refine the proposed solution. The objective is to validate the new technology solution that a customer can transition in Phase III. Validate the feasibility of the Phase I concept by development and demonstrations that will be tested to ensure performance objectives are met. Validation would include, but is not limited to, system simulations, operation in test-beds, or operation in a demonstration subsystem. This phase should result in a prototype with substantial commercialization potential.

PHASE III: The contractor will apply the innovations demonstrated in the first two phases to one or more missile defense applications. The objective is to demonstrate the scalability of the developed technology, transition the component technology to the missile defense system or payload contractor, mature it for operational insertion, and demonstrate the technology in an operational environment. Commercialization: The contractor will pursue commercialization of the various technologies and models developed in Phase II for potential commercial uses in such diverse fields as network management, cell communications, air traffic control, finance, and other industries.

REFERENCES:

1. D. S., Modha, et al. August 2011. “Cognitive Computing.” Communications of the ACM, Vol. 54, No.8

2. Ahlem Walha, Ali Wali, and Adel M. Alimi. December 2012. “Support Vector Machine Approach for Detecting Events in Video Streams.” Advanced Machine Learning Technologies and Applications Communications in Computer and Information Science, Volume 322: 143-151.

3. Lawrence A. Klein. September 2012. Sensor and Data Fusion: A Tool for Information Assessment and Decision Making, Second Edition.

KEYWORDS: Artificial Intelligence, Cognitive Computing, Target Recognition, Database Management & Information Retrieval, Image Processing, Database Information Retrieval

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MDA15-002 TITLE: Kinematic Reach/Containment

TECHNOLOGY AREAS: Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop and demonstrate improvements that will increase missile kinematic reach and containment against advanced threats.

DESCRIPTION: Seek innovative improvements and creative applications of mature product and material technologies that can address increased kinematic performance and containment. Reducing mass while maintaining or increasing performance (more divert delta V or more efficient use of packaged delta V) will increase the kinematic reach and containment of the vehicle. These innovations can range from light weight rocket motor components minimizing missile stage inert mass, innovative high temperature non-eroding materials that can survive higher temperature environments (> 5000 F for approximately 120 s for kinematic reach and > 3500 degrees F for approximately 300 s for containment) to innovative propulsion components which enable greater performance. This may involve innovative research and development, advanced material characterization testing, development of improved material manufacturing and component manufacturing processes, etc., that lead to a specific products for improved missile kinematic performance.

PHASE I: Develop a proof-of-concept solution; identify candidate materials and manufacturing processes. Complete a preliminary evaluation of the process, technique or manufacturing technology showing the assessment of improvement through improved performance and/or reduced inert mass. At completion of this program the design and assessment will be documented for Phase II.

PHASE II: Expand on Phase I results by producing components, demonstrating manufacturing processes and inspection process. These activities will provide data to support the studies completed in the Phase I program to substantiate the performance improvements. This will allow a more thorough assessment of the technology for missile defense applications.

PHASE III: The developed process/product should have direct insertion potential. Conduct engineering and manufacturing development, test, evaluation, qualification. Demonstration would include, but not limited to, demonstration in a real system or operation in a system level test-bed with insertion planning for a missile defense application. Commercialization: The technologies developed under this SBIR topic should have applicability to the defense industry as well as other potential applications such as commercial space flight and commercial industries which employ the use of energetic chemicals.

REFERENCES:

1. George P. Sutton. 2001. "Rocket propulsion Elements; Introduction to Engineering of Rockets." 7th edition, John Willey &Sons.

2. Department of Defense. January 23, 1997. MIL-HDBK-17: Department of Defense Handbook: Composite Materials Handbook.

KEYWORDS: High Temperature Materials, Ceramic Matrix Composites, Energetic materials

TPOC: Chris Jones
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MDA15-003 TITLE: System Communications

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Elicit innovative concepts and products to develop mitigation strategies or alternative approaches to lower communication link latency and increase bandwidth without modification to hardware while also keeping communications secure and reliable.

DESCRIPTION: As new missile defense CONOPS are developed, the requirements placed on weapon data links will increase. Lower latencies and higher data rates will be needed as weapons become more agile, targeting error requirements become tighter, and the need for real time data become greater. In order to support future network communications, innovative concepts and technologies are needed to develop mitigation strategies and alternative approaches to lower link latency issues without the need for hardware modification. The more stressing environments of future systems including engagement coordination scenarios and stress communications networks require future networks to account for improvements in:

- Lower Latency
- Increased Bandwidth
- Increased Data Rates
- Transmission Accuracy Coordination algorithms that take advantage of alternate satellite and non-satellite based communication can be considered.

Also, considerations should be made for latency and alternatives in case of link failure.

PHASE I: Develop a proof of concept design/study; identify designs/models, and conduct a feasibility assessment for the proposed algorithm, model, technique, and/or methods. Work should clearly validate the viability of the proposed solution with a clear concept of operation document.

PHASE II: Based on the results and findings of Phase I, develop and refine the proposed solution. The objective is to validate the new technology solution that a customer can transition in Phase III. Validate the feasibility of the Phase I concept by development and demonstrations that will be tested to ensure performance objectives are met. Validation would include, but not be limited to, system simulations, operation in test-beds, or operation in a demonstration subsystem. This phase should result in a prototype with substantial commercialization potential.

PHASE III: Apply the innovations demonstrated in the first two phases to one or more missile defense applications. The objective of Phase III is to demonstrate the scalability of the developed technology, transition the component technology to a system integrator or payload contractor, mature it for operational insertion, and demonstrate the technology in an operational level environment. Commercialization: The contractor will pursue commercialization of the various technologies and models developed in Phase II for potential commercial uses in such diverse fields as network, cell, and financial communications, and other industries.

REFERENCES:

1. James P. G. Sterbenz and Joseph D. Touch. May 2, 2001. High-Speed Networking: A Systematic Approach to High-Bandwidth Low-Latency Communication.

2. A. P. Godse and U. A. Bakshi. January 1, 2009. "Analog Communication." Technical Publications.

3. David Tse and Pramod Viswanath. 2005. "Fundamentals of Wireless Communication." Cambridge University Press.

KEYWORDS: Communications, Link Latency, Bandwidth, Transmission Accuracy

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MDA15-004 TITLE: Lethality Enhancement

TECHNOLOGY AREAS: Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop advanced technologies in reactive materials and the processes used to produce them to enhance lethality of kinetic warheads.

DESCRIPTION: The topic will study the incorporation of innovative reactive materials into a kinetic warhead to increase lethality. Emphasis will be placed on reactive materials that would achieve high reaction temperatures (>4000K) and generate high amounts of chemical energy (>2kcal/g) on impact. The need exists to develop and test reactive materials with varying densities from 1 g/cm3 to 10 g/cm3 as substitutes (with proper strength, ductility, etc.) for inner plastics, aluminum and steel components, etc. or as an add on structure. Proposed solution should enable design of material with specific reaction rates. Investigate cost effective fabrication technologies that are scalable to production. Proposer should tailor reactive materials and manufacturing processes to warhead applications.

PHASE I: Analyze, evaluate and conduct feasibility experimentation of the proposed lethality enhancement materials including material characterization and fabrication. Complete preliminary evaluation of the process, technique or manufacturing technology showing improved performance and/or reduced inert mass.

PHASE II: Design, fabricate and test prototype-scale device or components under conditions which simulate targets and velocities of interest. Demonstrate applicability to selected military and commercial applications. These activities will provide data validating the studies completed in the Phase I effort with the performance improvements. This will allow a more thorough assessment of the technology for missile defense applications.

PHASE III: Conduct engineering and manufacturing development, test, evaluation, and qualification in a missile defense system or demonstrate operation in a system level test-bed with insertion planning for a missile defense application. Commercialization: The technologies developed under this SBIR topic would have applicability to areas such demolition and blasting, fusible links for electrical circuit protection, combustible structures, cutting torches, etc. The technologies developed should also have applicability to defense industry as well as other potential applications such as commercial space flight and commercial industries which employ the use of energetic chemicals.

REFERENCES:
1. R. Lloyd. 2001. “Physics of Direct Hit and Near Miss Warhead Technology.” American Institute of Aeronautics and Aeronautics.

2. M. A. Meyers. 1994. “Dynamic Behavior of Materials.” Wiley Interscience.

KEYWORDS: Lethality Enhancements, Reactive Materials, Kinetic Warheads

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MDA15-005 TITLE: Gaming Trainer

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Develop a technique that can be used to enhance the Warfighter's operational proficiencies with ballistic missile battle management, providing visual and/or competitive rewards, i.e. points.

DESCRIPTION: Several missile defense training systems exist to assist the Warfighter in learning and becoming operationally proficient with the system. This topic seeks to take this a step further by leveraging gaming technologies to determine critical areas of performance and to also design a wrapper to encourage the users to "play" the system, exercising those critical components to refine performance. Modeling and simulation using white cell participants is a common method of training. However, no methods using this approach give instant feedback in a competitive gaming environment. The goal of this topic is to analyze current gaming techniques and determine if any of them could be applied to missile defense battle management training. The effort should address and investigate methodologies for improving learning, participation, and motivation through the application of gaming technologies. Feedback should include some type of reward, possibly points, where the users can compete for skill levels. In planning a missile defense design, the blue force asset lay-down (consisting of sensors, shooters, and command and control (C2) elements) will vary in number. Collaboration between shooters via their elements also varies based on both proximity (communications restrictions) and capability. The threat (red force asset lay-down) will also vary in number and capability. Particularly in Phase I, the researcher can assume simple kinematic impact of nominal missile defense threat trajectories in order to create threat scenarios for scoring analysis. The researcher can also assume simple sensor characteristics when determining intercept timelines. Shooters may consist of single or multiple missile configurations with basic ballistic missile trajectories. The goal is not to replicate current missile defense planning system analysis capabilities, or to develop placement optimization routines, but to focus on innovative ways to assess threat (red force) versus asset (blue force) missile defense design scenarios and to score the results in order to provide dynamic feedback to the operator. This feedback capability will optimize operator training with respect to determining planning methodologies and inherently improve retention and overall knowledge of battlespace management. A key focus of the innovation is identifying the set of variables, parameters and skills over which performance levels should be tested.

PHASE I: Develop and demonstrate a gaming concept utilizing a missile defense design scoring algorithm that accommodates multiple threats of varying types and capabilities pitted against multiple sensors, shooters, and C2 elements also with varying capabilities. Provide feedback to the game participant in a quantitatively measurable format. Provide the capability to compare these “scores” based on the participant’s alternatives or courses of action.

PHASE II: Refine and update concept(s) based on Phase I results, and demonstrate the impacts of attrition based on both missile expenditure and/or loss of defense assets during raid scenarios in stressing environments. Demonstrate how the gaming concepts improve the operator’s ability to quickly plan for variations in red force and blue force laydown restrictions. The government may choose to provide a government test bed at no cost if the developer wishes to utilize the facility for high fidelity testing.

PHASE III: Demonstrate the new technologies via operation as part of a complete system or operation in a system-level test bed to allow for testing and evaluation in realistic scenarios. Transition technologies developed under this solicitation to relevant missile defense elements directly or through vendors. Commercialization: The contractor will pursue commercialization of the various technologies and optimization components developed in Phase II for potential commercial and military uses in many areas such as disaster drill planning, automated processing, accident trauma response planning, and manufacturing processes. There are many applications of planning for events that are rare and it is difficult to train adequately to maintain the needed top response skills. Turning training into a "game" with rewards would incentivize the user to train more frequently to maintain top skill levels.

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KEYWORDS: Defense Planning, Battlespace Management, Gamification, Training

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MDA15-006 TITLE: Command and Control Human-to-Machine Interface

TECHNOLOGY AREAS: Human Systems

OBJECTIVE: Develop innovative human-to-machine interface technologies that present information more intuitively and that enable users to process more information efficiently.

DESCRIPTION: Command and control human-to-machine interface is critical to overall missile defense system performance due to human decisions and interactions associated with command and control systems. Recent advances in virtual reality, stereo-graphics, touch screen interfaces, and automated decision aides have the potential to revolutionize how Warfighters interact with command and control systems by providing situational awareness capabilities that immerse Warfighters in the battlespace environment and present relevant information for quick decisions. Innovations developed under this topic should be in graphical displays or techniques to effectively transmit critical information quickly and effectively to achieve an understanding of the underlying patterns, interrelationships of the data, and particularly critical aspects. Optimal visual representations of missile defense data form the basis for inferences and decisions. However, a poorly chosen graphical form can lead to erroneous inferences and potentially degrade performance. Important components will be the time varying nature of the data, as well as varying priorities across space and time and various accesses, i.e. different users will have different authority and visibility on the system. The graphical display system could be operated when the BMDS Warfighter is subject to considerable stress, so the system needs to be designed to accommodate such use. In addition, the system needs to be flexible and adaptable for new types of information. The underlying battle management framework exists to interoperate with the necessary tactical data link, mapping, and analysis engines. Therefore, the intent of this effort is not to create “yet another missile defense situational awareness display”, but to design and develop an original, innovative, and effective approach to human-to-machine interaction. The proposer should assume that, for the tactical situation display, data fusion and correlation algorithms are not part of this effort.

PHASE I: Develop and demonstrate an original, innovative situational awareness and engagement management human-to-machine interface concept. Research and provide evidence as to how this approach improves situation recognition and reaction times through proof-of-principle tests utilizing simple battlespace management situations provided to the operator. Demonstrate how this technology can be used to enhance both C2BMC training and operational processes.

PHASE II: Refine and update concept(s) based on Phase I results and demonstrate the technology in a realistic environment using government provided operations scenarios. The deliverable would be a working prototype that demonstrates a missile defense situational awareness and engagement management environment that enables an individual to interact with the situation and make decisions quickly. Demonstrate the technology’s ability in a stressed raid environment with multiple input data sources and user types.

PHASE III: Demonstrate the new technologies via operation as part of the complete missile defense battle management system or operation in a system-level test bed to allow for testing and evaluation in realistic scenarios. A successful prototype could be transitioned into a battle management training and/or operational system. Market technologies developed under this solicitation to relevant missile defense elements directly, or transition them through vendors. Commercialization: The contractor will pursue commercialization of the various technologies and optimization components developed in Phase II for potential commercial and military uses in many areas such as 911 centers, battlefield displays, integrated air and missile defense, or trauma triage displays.

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KEYWORDS: Human Machine Interface, Virtual Reality, Training

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MDA15-008 TITLE: Improved Track Accuracy for Missile Engagements

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Seek innovate, next-generation radar data/signal processing techniques and algorithms that will improve the metric accuracy for tracking interesting objects in a missile defense engagement.

DESCRIPTION: Missile defense performance is dependent on the efficient acquisition, tracking, and discrimination of threatening objects by disparate and geographically dispersed sensors. Precision tracking is a key component for all phases of a missile defense engagement to ensure efficient use of resources and to enhance each component's contribution to the success of such engagements. Candidate solutions should address improvements in track accuracy for interesting objects following a ballistic trajectory, while retaining a robust capability to maintain track continuity, accuracy, and purity, against evolving threats with increasing complexity. The expectation is that any final product from this solicitation will yield improvements in the accuracy of sensor tracking data that will enhance the effectiveness for all missile defense stakeholders whose technologies rely on precision track data. Innovative solutions that utilize real-time, near real-time, and/or hybrid techniques will be considered. Solutions that are adaptable to several radar frequency bands are preferred, but single band solutions will be considered. The radar tracking coefficients, where accuracy improvements are expected, include: measured position and velocity, predictive track propagation (with uncertainty), track correlation, and track purity.

PHASE I: Develop and conduct proof-of-principle studies and/or demonstrations of track accuracy techniques and algorithms that are easily adaptable to a wide range of sensors using simulated sensor data.

PHASE II: Update/develop algorithms based on Phase I results and demonstrate technology in a realistic environment using data from multiple sensor (as applicable) sources. Demonstrate ability of the techniques and algorithms to work in real-time, high clutter, and/or countermeasure environment.

PHASE III: Integrate techniques and algorithms into missile defense systems and demonstrate the overall updated capability. Pursue partnerships with DoD system integrators. Commercialization: The contractor will pursue commercialization of the various technologies developed in Phase II for potential commercial and military uses in many areas such as weather radar, air traffic control, or satellite tracking.

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KEYWORDS: Tracking, Track Accuracy, Statistical Interference, Bayesian Network, Algorithms, Techniques, Feature Extraction

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MDA15-010 TITLE: Innovative Methodologies for Modeling Fracture Under High Strain-rate Loading

TECHNOLOGY AREAS: Information Systems, Weapons

ACQUISITION PROGRAM: Corporate Lethality Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop an innovative tool for modeling fracture under high strain-rate loadings, using first-principles finite-element codes. Tools developed should address strain rates from 10 s^-1 to 10^7 s^-1 due to high-velocity impact or explosive loadings. Current high confidence modeling uses damage models that are computationally expensive.

DESCRIPTION: Seek high fidelity modeling tools for fracture mechanics that are accurate and cost effective for post intercept debris prediction. Acceptable solutions potentially incorporate improved damage models, meshless methods, "peridynamics," or any combination thereof. Use of first-principles codes to predict the characteristics of post-intercept debris requires prediction of fracture and cracking of aerospace structures. Prediction of crack initiation and propagation can be done using a mesh that follows the crack, but this is time-consuming since it involves re-building the model (re-meshing) in the region of interest. Finite element codes, or hydro-codes (e.g. Dyna, Paradyn, Zapotec, Velodyne, etc.), must capture events on extremely short time-scales for high-rate problems such as high-velocity impact or explosive loading of structures. Within this group of codes, methodologies that address fracture, crack growth, shear bands, and voids are all of interest. Fracture is a challenging problem in applied mechanics and both improved modeling and computational cost are critical to a successful approach.

PHASE I: Investigate the feasibility of new damage models or modeling approaches in first-principles codes. Select a tractable problem on an appropriate scale with a known solution or experimental data for verification of the proposed methodology and demonstrate the feasibility of the approach using a representative structural model (incorporating materials commonly used in aerospace structures) with high-rate loadings (e.g. high-velocity impact or explosive loading) that would cause cracking or fracture on the time-scales (at least 20ms duration) of this type of problem. Demonstrate improvements to the fidelity of fracture predictions and assess the computational cost.

PHASE II: Perform further demonstration of the methodology proposed in Phase I through application to more complex, larger-scale models of interest, and use of a broader range of experimental data sets. Include implementation of this methodology to predict fracture and crack-growth in full-scale testing, such as flight, sled, or arena tests.

PHASE III: Transition the first-principle physics-based modeling capability developed under this program to lethality and debris prediction efforts. Execute model runs for design and analysis cases of interest to missile defense applications including flight test and engineering codes. Commercialization: An innovative application of generalized finite element methods or other fracture modeling approaches to first-principles codes or hydro-codes could then be applied in the defense and aerospace industries wherever high strain-rates appear due to high-velocity impact or explosive loadings, or in other applications such as mining or demolitions where explosive loadings are involved.

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KEYWORDS: Explicit Finite Element Codes, Hydrocodes, Generalized Finite Element Method, Fracture, High-Rate Loadings

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MDA15-014 TITLE: Thermally Efficient Emitter Technology for Advanced Scene/Simulation Capability in Hardware in the Loop Testing

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Identify, develop and demonstrate infrared (IR) emitter technologies that achieve high output capability while reducing critical thermal management requirements for large format scene projection systems.

DESCRIPTION: Ground testing of exo-atmospheric interceptor IR sensors play an essential role in the development of advanced algorithm concepts, mitigating flight test risk/cost and evaluating tactical performance. Numerous next-generation IR emitter technologies such as IR light emitting diodes (LEDs), photonic crystals and resistors are in development. These devices address the need for greater projected temperature ranges, faster frame update rates and very large array formats but present challenges in managing parasitic/waste heat. This solicitation seeks new and innovative emissive technologies to enable presentation of dynamic high-temperature scenes at higher frame rates for high fidelity IR projection in ground test environments to meet the test requirements for larger formats and more stressing tactical environments where thermal management is not a dominating factor. The end result will provide a capability to evaluate exo-atmospheric IR sensors and target tracking/discrimination algorithms in ground test facilities with increasing confidence of success prior to flight test. Technical goals of this topic include:

- Pixel scene resolution of 4K x 4K
- Frame rates > 400Hz
- Flickerless display
- Compatible with cryogenic chamber operation (~100K)
- MWIR/LWIR scene temperatures of 2000K
- Native non-uniformity <10%
- Cross-Talk <1%
- Dynamic range 16-bits

PHASE I: Conduct a feasibility study to identify one or more innovative thermal efficient emitter solutions that meet the temperature/speed goals and show promise to implement in extremely large formats. Emitter to emitter spacing (pitch) must be minimized to avoid area-defect yields and ease optical interfacing challenges. Identify addressing and drive schemes to achieve flickerless display. Use of modeling and simulation to conduct trade studies, optimize efficiency, predict overall performance, and forecast power requirements is essential. Preliminary testing of materials at the "coupon" level to anchor model predictions is desirable.

PHASE II: Develop and execute an incremental test & integration plan that will address the technology challenges and produce a prototype/breadboard system for evaluation. Define any technology shortfalls and document the recommendations for resolution and update system level model.

PHASE III: Based on Phase II lessons learned, revise the system model to proof-out the new design. Develop and execute an incremental test & integration plan that will produce a final prototype. Demonstrate interface capability via bench test of a government furnished very large format array at cryogenic temperature. Commercialization: The primary market for thermally efficient materials for extremely large infrared projectors will be military and civilian government agencies with applications requiring testing of munition and surveillance sensors.

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KEYWORDS: Infrared Projector, Emitter Array, Thermal Management, Cryogenics

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MDA15-017 TITLE: Innovative Antenna Arrays Enabling Continuous Interceptor Communications

TECHNOLOGY AREAS: Information Systems, Sensors, Electronics

ACQUISITION PROGRAM: Advanced Technology - DV

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop an antenna array to support existing/future transceiver technologies for implementation into missile defense applications. This antenna array should enhance the performance and/or producibility of communication systems while reducing size, weight, and, power.

DESCRIPTION: Phased antenna arrays are expensive, heavy systems with complex hardware configurations. Despite these complexities, phased arrays are advantageous in situations where mechanical steering is impractical. In the past decade, there has been maturation in technology regarding the use of digital beamforming (DBF) to substantially augment the system-level capabilities of phased array antennas. However, disadvantages of this “work-around” include potential high power consumption, data latency and throughput introduced by digitization and beamforming operations. This topic solicits ideas to develop radio frequency antennas that are innovative, reliable, radiation hardened, and support high speed continuous communications between fire control and interceptor/kill vehicles in an operational fading channel environment throughout all stages of flight without reorientation requirements. Proposed communications schemes should have the lowest possible weight impact on the kill vehicle. Favorable solutions will consider multiple communication paths including communication terminals, satellites, and missile vehicles. The system must establish an ultimate link between the kill vehicle and ground control with scalable transmission power and ranges. Reduction in the antenna array footprint on the kill vehicle is also desired including flexible ultra wideband, conformal, and fractal antenna solutions that are capable of receiving signals from a large range of orientations.

PHASE I: Conduct an initial design evaluation of proposed systems and perform any laboratory/breadboard experimentation or numerical modeling needed to verify the proposed method. The contractor should identify the strengths/weaknesses associated with different solutions, methods and concepts.

PHASE II: Based on the optimal communication antenna array design proposed in Phase I, the contractor should complete a detailed prototype design incorporating government performance requirements. Fabricate and test a prototype for hardness, reliability, and performance in a simulated environment to verify theoretical/design assumptions. The final deliverable will be a detailed performance analysis of the experiment, an antenna prototype, and an initial design of an engineering development model of the resulting communications system. The contractor should coordinate with solicitor during prototype design and development to ensure products will be relevant to ongoing and planned projects.

PHASE III: Either solely, or in partnership with a suitable production foundry, implement and verify in full scale that the Phase II demonstration technology is economically viable. Assist solicitor in transitioning the technology to the appropriate system or payload integrators for engineering implementation and testing. Develop and execute a plan for marketing and manufacturing.
Commercialization: Innovations developed under this topic will benefit both DoD and commercial space and terrestrial programs. Possible uses for these products and techniques include long-range line-of-sight communications systems for satellites or aircraft.

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KEYWORDS: Communications, Datalink, Radio, SATCOM, Satellite, Communications Architecture, Jamming, High Altitude Nuclear Explosions, Fading Channels, End To End Communications, Communication Systems, Radio Frequency, Antenna, Antenna Array, Ultra Wideband, Phased Array, Continuous, Link, Conformal, Fractal, Kill Vehicle

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MDA15-018   TITLE: Multi-Object Payload Deployment

TECHNOLOGY AREAS: Weapons

ACQUISITION PROGRAM: DV

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop innovative solutions for restraining and deploying multiple payloads for missile defense applications. This topic should focus on methods of restraining and deploying payloads through adverse flight environments while minimizing size, weight, and power and induced loads.

DESCRIPTION: Future weapon systems may be required to deliver multiple payloads. A key technological driver for multi-object payload vehicles is the restraint and deployment method. This topic seeks innovative solutions to reliably restrain and release the payloads with precise deployment dynamics. Restraint technology must withstand high axial shock and acceleration loads. Payload deployment dynamics should create low radial acceleration loads. Deployment will occur outside the atmosphere and technologies should offer flexible (simultaneous/sequential) deployment. The design should interface with current missile defense platforms. For the purposes of Phase I, deployable payloads should have identical configurations, each with a mass range between 10-30kg.

PHASE I: Conduct a design that shows the feasibility of the concept, backed with low-fidelity, proof-of-concept component testing. The proposer should provide estimated performance and reliability characteristics.

PHASE II: Refine the concept through detailed design and analysis including fabrication of hardware. Testing should include multiple test series that demonstrate the restraint and deployment characteristics of the design. This phase should conclude with an updated design based on test results. The proposer should provide performance and reliability characteristics.

PHASE III: Demonstrate the scalability of the developed technology, transition the technology to the missile defense system integrator or payload contractor, and ensure maturity for operational insertion into missile defense applications. Demonstration would include, but not limited to, demonstration in a missile defense system or operation in a system level test-bed with insertion planning for a missile defense application. Commercialization: The proposal should show that the innovation has benefits to both commercial and defense applications. Technology developed can be applied to commercial satellite or launch platforms; weaponry; or military aircraft. The projected benefits should demonstrate cost reduction and improve producibility or performance of products that use the technology. The proposer should estimate the market size for both commercial and defense applications. Success in this research area should strengthen available and reliable hardware for use at missile defense application Department of Defense Agencies, and commercial entities.

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KEYWORDS: Separation, Deployment, Dispense, Payloads, Multi-Object, Restrain, Low-Shock, Mechanism

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MDA15-020 TITLE: Interceptor Thermal Protection Systems

TECHNOLOGY AREAS: Materials/Processes, Weapons

ACQUISITION PROGRAM: DV

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop innovative solutions to advance interceptor thermal protection systems. This topic focuses on methods of reducing mass, while maintaining performance and allowing for the integration of robustness and reliability features.

DESCRIPTION: Objectives for future missile defense applications include increased kinematic reach. One method of maximizing kinematic reach is through inert mass reduction. Interceptors require a significant amount of thermal protection system materials to survive fly-out trajectories. An example of current state-of-the-art material for thermal protection systems has a density of approximately 1.72 g/cm^3 (0.06 lbm/in3) and possesses a thermal conductivity of approximately 0.36 W/m-K. Innovative material solutions are sought to extend beyond the state-of-the-art. Robustness may be addressed within the thermal protection system by integrating features that address Electro-Static Discharge (ESD), Electromagnetic Impulse (EMI), and Lightning Strike. Improvements in affordability may be addressed through manufacturing processing or component integration. Additional features for potential integration are antennas, cables & connectors, raceways, etc. The advanced material must be dimensionally and chemically stable during typical missile storage and flight environments.

PHASE I: Evaluate the feasibility of the material concept, backed with proof-of-concept material testing. Provide estimated performance and reliability characteristics.

PHASE II: Continue development of the material and associated concepts through detailed design and analysis including fabrication of material and subscale hardware. Developmental testing should be conducted to validate modeling and property databases. Evaluate material aging affects. Provide in-house and independent verification and validation. Provide performance and reliability characteristics. Phase II should conclude with an updated design based on test results.

PHASE III: Demonstrate the scalability of the developed technology, transition the technology to a missile defense system integrator or payload contractor, and ensure maturity for operational insertion. Demonstrate operation in a missile defense system or in a system level test-bed. Plan insertion into a missile defense application. Commercialization: Develop and execute a plan to manufacture the prototype developed in Phase II, and assist in transitioning this technology to the appropriate missile defense system integrator for engineering integration and testing.

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KEYWORDS: Thermal Protection System, Materials, Lightning Strike, EMI, ESD, E3, Antennas, Raceways, Connectors, Cables, Material Testing, Coatings

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MDA15-022 TITLE: Low Light Short Wave Infrared Focal Plane Arrays

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Seek innovative solutions that support the development of Short-Wave Infrared (SWIR) Focal Plane Arrays (FPAs) and camera technologies for next generation missile defense applications.

DESCRIPTION: This topic focuses on enabling next generation sensors and improving FPA performance beyond the current state-of-the-art to support future missile defense applications. This topic seeks low noise, high sensitivity FPA technologies that detect very low signal levels. Current FPA technologies for imaging in low-light conditions at SWIR wavelengths are limited by poor quantum efficiency and/or poor noise characteristics. Silicon-based technologies offer low noise devices; however, the quantum efficiencies of these devices is typically a few percent at SWIR wavelengths. Technologies based on other substrates (HgCdTe, InGaAs, etc.) have fairly high quantum efficiencies (greater than 50%) at SWIR wavelengths, but the noise characteristics of these devices are typically too large for very low light sensing conditions. Technologies based on avalanche photodiodes (APDs) are capable of imaging in low-light conditions; however, APD technologies have limitations: in the case of Geiger mode

APDs, their response to input photon flux is non-linear and in the case of linear-mode APDs, their array sizes are small. This topic does not focus on particular substrate/readout integrated circuit combinations but solicits technical solutions for imaging objects under low light conditions at SWIR wavelengths. Goals for the topic are: 1) quantum efficiencies for silicon-based substrates that are greater than 60% (at 900nm), 35% (at 1000nm), and 20% (at 1100 nm) or quantum efficiencies for non-silicon-based substrates that are greater than 30% across the 900-1200 nm region 2) dark currents that are less than 100 electrons/pixel/second at 77K 3) readout noises less than 5 electrons 4) formats that are greater than 512 X 512 with extensibility to 1k X 1k 5) frame rates of 30Hz with integration times up to 30 milliseconds 6) programmable with capability of 2 X 2 binning of pixels 7) excess noise factor that is less than 2 for technologies that use gain 8) linear response to incident flux The proposed technologies should also include designs that mitigate the effects of harsh radiation environments to prevent catastrophic system failure.

PHASE I: Conduct modeling, simulations, and analysis (MS&A), and proof-of-principle experiments of the critical elements for the proposed FPA technology. This phase should validate the feasibility of the proposed technology. Phase I will conclude with a proof-of-concept design review of the detector technology to include a clear, concise technology development plan and schedule, predicted FPA performance metrics, a transition risk assessment, and associated requirements documentation. The contractor is strongly encouraged to collaborate and cultivate relationships with other system and/or sensor payload contractors to ensure the applicability of the FPA technology and to initiate work towards technology transition. No specific contact information will be provided by the topic authors.

PHASE II: Using the resulting processes, designs, techniques, and architectures, developed in Phase I, fabricate a prototype or engineering demonstration unit of the FPA technology. Perform characterization testing of the FPA within the program constraints of cost and schedule. The characterization tests should show the performance achieved from the FPA technology. Environmental testing: vibration, thermal, and radiation testing (if applicable) is encouraged. Differences between the MS&A and the FPA performance data should be noted. During this phase, the contractor should continue to collaborate and cultivate relationships with other system and/or sensor payload contractors while considering the overall objective of commercialization of the detector technology in Phase III.

PHASE III: The offeror will implement and verify in full scale, either solely, or in partnership with a suitable production foundry, that the Phase II demonstration technology is economically viable. Assist in transitioning the detector technology for missile defense applications to an appropriate contractor for engineering integration and testing. Commercialization: The contractor will pursue commercialization of the various technologies developed in Phase II for potential commercial uses in other government applications. In addition, there are potential applications for detector technologies in a wide range of diverse fields that include astronomy, commercial satellite imagery, optical and free-space communications, law enforcement, maritime and aviation sensors, spectroscopy, atmospheric measurements (in-situ and remote sensing), and terrain mapping.

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MDA15-023 TITLE: Solid State High Power Amplifier for Communications

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Determine the feasibility and design of an innovative solid state high powered amplifier (HPA) to support missile defense communications.

DESCRIPTION: The goal of this topic is to investigate solid state power amplifier (SSPA) technologies that meet or exceed the output power (greater than 1 kW), duty factor, operating frequency (K-band:20-22 GHz), reliability, sustainability, and supportability achievable with existing traveling-wave tube amplifiers as a potential replacement for klystron tubes in future communication systems. Klystron tube technology has reliability and supportability issues resulting from manufacturing processes and component (tungsten wire) availability. The proposed SSPA architecture should consist of a modular design which provides an additive power approach based on multiple radio frequency (RF) modules linked together to achieve desired power while providing for gradual degradation when a single RF module fails so components can be replaced without having to remove input power. Currently, input power must be cut when replacing a failed klystron. SSPA technologies that leverage built-in-tests and diagnostics to provide fault detection and isolation at a line replaceable unit level should be emphasized. This level of fault determination should allow for efficient replacement of failed hardware components and demonstrate enhanced safety for system operators and maintainers. Another goal of this topic is to demonstrate fast SSPA warm-up times (less than a 1 second “warm-up” time prior transmission). Finally, the proposed SSPA technology should demonstrate enhanced availability and reliability to meet operational readiness at minimal cost.

PHASE I: The contractor should develop a generic solid state HPA design that provides for future growth potential to support emerging interceptor communications requirements. The design should document expected reliability, availability, sustainability and supportability performance at power levels and duty factors that are sufficient for communications.

PHASE II: The contractor should transition the generic solid state high power amplifier design completed in Phase I into a system specific end item prototype suitable for testing via insertion into an existing missile defense application. The prototype and design documentation should be provided to the government.

PHASE III: The contractor should integrate the Phase II prototype into an existing government hardware string and then conduct subsystem and system level testing to ensure compatibility with legacy communication hardware components. The contractor will be expected to refine the design as needed to address any needed changes identified during testing to satisfy communication design/performance requirements. Commercialization: This innovative technology would have benefits for all commercial and/or defense systems applications operating in the X, Ka, K, & Ku bands requiring reliable, sustainable high power amplification of RF energy (e.g. commercial and military satellite communications) but the benefits are also applicable to bands above and below those specific bands. The contractor proposal should clearly explore and identify other specific applications for both commercial and defense systems.

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MDA15-024 TITLE: Non-Destructive Testing Methods for Detecting Red Plague Within an Insulated Silver Plated Copper Conductor

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Obtain a quantitative method for detecting and determining the extent of corrosion damage of Cross-Linked Ethylene-Tetrafluoroethylene (XL-ETFE) insulated silver plated copper wire due to Red Plague through a method such as using varying frequencies and levels of RF currents.

DESCRIPTION: Red Plague is a galvanic corrosion of silver coated copper materials which occurs when the silver coating does not adequately cover the underlying copper and is exposed to water by either direct contact or condensation. Red Plague causes degradation of the anodic copper while leaving the cathodic silver plating intact. More details for causes and current mitigation provided in in SAE-ARP-6400, the NASA Red Plague Control Plan, and the European Space Agency's "Corrosion of Silver-Plated Copper Conductor." Therefore, the silver "straw" can carry current during a normal incoming inspection conductivity test and most system level high-frequency checks, but without the copper's strength and ductility, silver cannot carry the shock and vibration load in flight environments. Silver plated copper wire provides many advantages over other conductor systems such as excellent solderability, crimpability, and flexibility. The intent of this topic is ultimately to create a system which can be used to perform non-destructive testing on XL-ETFE insulated silver plated copper wire and determine acceptability prior to implementation within hardware. One proposed method for creating this system is by utilizing the skin effect. As frequency of a signal increases, a given conductor will carry more and more of the signal on the "skin" of the conductor. This is often referred to as "skin effect." Conversely, as the frequency decreases a more uniform distribution of current within the conductor is obtained. Therefore, within a given length of XL-ETFE insulated silver plated copper conductor (with 40 microinch mean plating thickness), a method could be developed such that by applying signals at various frequencies, and measuring the AC impedance at frequency of the wire length it may be possible to determine relative extent of copper conductor degradation from varying degrees and numbers of sites of Red Plague corrosion. The levels of the variable frequency currents applied may also impact current density at corrosion sites and be used to determine effects to the characteristics of the wire from this corrosion.

PHASE I: Develop a non-destructive test method to detect the presence of Red Plague. Conduct experimental and/or analytical efforts to demonstrate that Red Plague can be created consistently within a lab environment for use in the analysis of the non-destructive testing (NDT) method. It is critical that the performing company can consistently create a known amount of damage due to Red Plague within an XL-ETFE wire for verification of the non-destructive test method.

PHASE II: Conduct experimental and/or analytical efforts to demonstrate proof-of-principle of proposed technology. Investigations shall consider the viability, feasibility, and cost-effectiveness of solutions to locate and quantify extent of Red Plague within XL-ETFE insulated silver plated copper conductor. Demonstrate the technology by developing a prototype in a representative environment. Demonstrate feasibility and engineering scale up of proposed technology as well as identify and address technological hurdles. Demonstrate the system’s viability and superiority under a wide variety of conditions typical of both normal and extreme operating conditions.

PHASE III: Successfully demonstrate direct applicability or near-term application of technology in one or more missile defense applications. Demonstration should be in a real system or operational in a system level test-bed. This demonstration should also verify the potential for enhancement of quality, reliability, performance, and reduction of total ownership cost of the proposed subject. Commercialization pathways should be identified for both military and civilian applications. Commercialization: Equally important to military utility is the transferability of proposed technologies to Red Plague detection in aerospace, automotive, and industrial uses. The proposed technology should benefit commercial and defense systems through cost reduction as well as improved reliability and sustainment. As enabling technologies, it is anticipated that commercial and industrial transferability and applicability of such technologies will be high.

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KEYWORDS: Red Plague, Corrosion

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MDA15-025 TITLE: Passive Inter-Modulation RF Emissions Utilized for Identifying Galvanic Corrosion in Metal Structures

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Seek innovative methods to detect passive inter-modulation (PIM) RF emissions from metal structures to detect corrosion points at sites on the metal structures.

DESCRIPTION: Corrosion is a major concern that causes premature deterioration or failure at damage sites in metal structures thereby necessitating monitoring, maintenance, repair or replacement. PIM emissions are a known problem for ships and land-based cellular systems where metal structures simultaneously receive RF radiation on two or more different signal frequencies. The received RF signal frequencies may then cause RF currents to flow in metal structures that can be non-linearly mixed together in metal-to-metal contacts in the structures affected by galvanic corrosion. These RF currents may then generate additional new intermodulation RF emissions from the structures due to sum and difference harmonic mixing of the two or more original frequencies. PIM may occur in a variety of areas from coaxial connectors to cables, rusty bolts, or any metallic structure joint where dissimilar metals or similar metals in an electrolyte occur. Corrosion sites could include poor, loose, or contaminated connectors, junctions between dissimilar metals, and mechanical connections that have become oxidized, or contaminated with typical corrosion chemicals found in missile defense systems. Demonstrate that PIM RF emissions have the capability to accurately detect and characterize degradation arising from galvanic corrosion processes in metal structures. Areas of emphasis include determining if various conditions of corrosion severity found at points on a metal structure can be accurately and repeatedly identified to determine where and when a particular corrosion site is an issue for concern. Furthermore, the information gained by the preceding effort should be evaluated for its capability to support corrosion degradation monitoring, corrosion modeling and determining applicable acceleration factors for galvanic and other combinational corrosion processes. Also desired from this effort is to determine whether the RF currents that circulate due to RF radiation impinging on the metal structures increase the PIM emissions. Resolve how RF radiation affects or accelerates existing galvanic corrosion processes in the structures.

PHASE I: Demonstrate a proof-of-concept for detecting PIM RF emissions from metal structures and provide analysis of how effectively the measurements are employed to detect and locate the corrosion points at sites on metal structures. Identify prototype equipment items, develop a preliminary equipment design and document developed techniques.

PHASE II: Perform testing of a PIM detection prototype to obtain information on PIM emission "signatures" of corrosion sites with known differing metallurgical characteristics. Demonstrate that the results are accurate and repeatable enough to provide a basis for degradation monitoring, corrosion modeling and determination of corrosion model acceleration factors. Develop a library of repeatable signatures of corrosion to include metallurgical characteristics at corrosion sites such as joint contact pressure, surface topology, current density and area of the contact point.

PHASE III: Develop a final equipment design and hardware and transition to the government. This phase is to obtain improved capability for identifying the presence and progression of underlying galvanic corrosion in metal-to-metal contacts. This effort offers significant cost avoidance for missile defense applications. Positive results from this project have great potential to improve system reliability, and to reduce the costs of metal structure corrosion from material and systems functional loss within the DoD, and on a national commercial level. Commercialization: In the U.S., total direct cost of corrosion is estimated at about 300 billion dollars per year; which is about 3.2% of domestic product. Corrosion also interferes with human safety, disrupts industrial operations and presents dangers to the environment. Positive results from this project have great potential to improve system reliability and to reduce the costs of metal structure corrosion within the DoD and on a national commercial level.

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KEYWORDS: Radio Frequency Emissions, Passive Inter-Modulation Emissions, Galvanic Corrosion

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