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

INTRODUCTION

The MDA 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:

Dr. Douglas Deason
Director, Advanced Research
E-mail: sbirsttr@mda.mil
Phone: (256) 955-2020

MDA/DVR
Bldg 5224, Martin Road
Redstone Arsenal, AL 35898

Additional information on the MDA SBIR/STTR Program can be found on the MDA SBIR/STTR home page at http://www.mdasbir.com. Information regarding the MDA mission and programs can be found at http://www.mda.mil.

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.

Questions about SBIR and Solicitation Topics

Refer to Section 1.5 of the Do-D solicitation at www.dodsbir.net/solicitation.

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 on 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.

Conflicts of Interest
Refer to Section 1.4 of the DoD solicitation at: www.dodsbir.net/solicitation.

PHASE I GUIDELINES

MDA intends for the Phase I effort to determine the merit and technical feasibility of the concept. Phase I proposals may be submitted with a period of performance of 6 months and a base amount not to exceed $100,000. The Phase I Option may be submitted with a period of performance of 6 months and an amount not to exceed $50,000. A list of the 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. The topics originated from the MDA Programs and are directly linked to their core research and development requirements.

MDA acknowledges that universities engaging in fundamental research are free to involve foreign researchers and to publish their research in a public forum except in cases where restrictions are placed for reasons of National Security. However, in accordance with Section 2.4 of the DoD solicitation, ALL offerors proposing to use foreign nationals MUST disclose this information regardless of whether the topic is subject to ITAR restrictions. To ensure only fundamental research is published, MDA requires the proposal to document specifically which portion of the SOW will be conducted by the university as fundamental research. MDA will review the SOW and provide approval \ disapproval of the designation of university work as fundamental research during the contracting process. The small business will remain responsible for control of information deemed ITAR on their contract and\or the passing of ITAR data to the university.

Please ensure that your mailing address, e-mail address, and point of contact (Corporate Official) listed in the proposal are current and accurate. MDA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission.

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 a.m. (ET) 26 September 2012.

_____ a. DoD Proposal Cover Sheet

_____ b. Technical Proposal (**DOES NOT EXCEED 20 PAGES**): *Any pages submitted beyond this will not be evaluated. Your cost proposal and Company Commercialization Report DO NOT count toward your maximum page limit. Proposal Coversheets DO 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. DoD Company Commercialization Report (required even if your firm has no prior SBIRs).

_____ e. Cost Proposal **(Online cost proposal form is REQUIRED by MDA)**

____2. The Phase I proposed cost plus option does not exceed $150,000.

USE OF FOREIGN NATIONALS

See Section 2.3 of the DoD program solicitation 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 ITAR restrictions. See Section 3.5, b.(7) of the program solicitation for required information.

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.

ITAR RESTRICTIONS

The technology within some MDA topics is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. You must ensure that your firm complies with all applicable ITAR provisions. Please refer to the following URL for additional information: http://www.pmddtc.state.gov/compliance/index.html.

Proposals submitted to ITAR 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.

PHASE I PROPOSAL SUBMISSION

The DoD SBIR/STTR Proposal Submission system (available at http://www.dodsbir.net/submission) will lead you through the preparation and submission of your proposal. Read the front section of the DoD solicitation, including Section 3.5, for detailed instructions on proposal format and program requirements. Proposals not conforming to the terms of this solicitation will not be considered.

MAXIMUM PAGE LIMIT FOR MDA IS 20 PAGES

Any pages submitted beyond the page limit will not be evaluated. Your Cost Proposal and Company Commercialization Report DO NOT count toward your maximum page limit. Proposal coversheets, which will be added electronically by the DoD submission site as page 1 and page 2, DO count toward your maximum page limit.

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

MDA is implementing 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 proposal is being evaluated and if selected, the contract is being negotiated. Only Phase I efforts invited to propose for a Phase II award through MDA's competitive process will be eligible for MDA to exercise the Phase I Option, if MDA so chooses. The Phase I Option, which **must** be included as part of the Phase I proposal, covers activities over a period of up to six months, if exercised, and should 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.

A firm-fixed-price Phase I Cost Proposal ($150,000 maximum, including option) must be submitted in detail online. Proposers that participate in this Solicitation must complete the Phase I Cost Proposal not to exceed the maximum dollar amount of $100,000 and a Phase I Option Cost Proposal (if applicable) not to exceed the maximum dollar amount of $50,000. Phase I and Phase I Option costs must be shown separately but may be presented side-by-side on a single Cost Proposal. The Cost Proposal DOES NOT count toward the 20-page Phase I proposal limitation.

MDA PROPOSAL EVALUATIONS

MDA will evaluate and select Phase I 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 will utilize the Phase I Evaluation criteria in Section 4.2 of the DoD program solicitation, including potential benefit to the Ballistic Missile Defense System (BMDS) in assessing and selecting for award those proposals offering the best value to the Government.

MDA will use the Phase II Evaluation criteria in Section 4.3 of the DoD solicitation, including potential benefit to BMDS and ability to transition the technology into an identified BMDS, in inviting, assessing and selecting for award those proposals offering the best value to the Government. In the Phase II Evaluations, Criterion C is more important than Criteria A and B, individually. Criteria A and B are of equal importance.

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 DoD program solicitation Section 3.5d.

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

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 and their personal knowledge. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be contained or referenced in the proposal and will count toward the applicable page limit.

Qualified advocacy letters 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. Consistent with Section 3-209 of DoD 5500.7-R, Joint Ethics Regulation, which as a general rule prohibits endorsement and preferential treatment of a non-federal entity, product, service or enterprise by DoD or DoD employees in their official capacities, letters from government personnel will NOT be considered during the evaluation process.

A qualified advocacy letter is from a relevant commercial procuring organization(s) working with MDA, articulating their pull for the technology (i.e., what BMDS need 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 of your technical upload. Advocacy letters which are faxed or e-mailed separately will NOT be considered.

INFORMATION ON PROPOSAL STATUS

The Principal Investigator (PI) and Corporate Official (CO) indicated on the Proposal Coversheet will be notified by e-mail regarding proposal selection or non - selection. If your proposal is tentatively selected to receive an MDA award, the PI and CO will receive a single notification. If your proposal is not selected for an MDA award, the PI and CO may receive up to two messages. The first message will provide notification that your proposal has not been selected for an MDA award and provide information regarding the ability to request a proposal debriefing. The second message will contain debrief status information (if requested), or information regarding the debrief request. **Small Businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the proposal number and topic number referenced.**

IMPORTANT: We anticipate having all the proposals evaluated and Phase I selection and non-selection notifications distributed in the December 2012 timeframe. All questions concerning the evaluation and selection process should be directed to the MDA SBIR/STTR PMO.

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

MDA SUBMISSION OF FINAL REPORTS

All final reports will be submitted in accordance with the Contract Data Requirements List (CDRL) of the resulting contract. Refer to Section 5.3 of the DoD Solicitation for additional requirements.

PHASE II GUIDELINES

This Solicitation solicits Phase I proposals. For Phase II, no separate solicitation will be issued and no unsolicited proposals will be accepted. Only those firms that were awarded Phase I contracts, and have successfully completed their Phase I efforts, may be invited to submit a Phase II proposal. MDA makes no commitments to any offeror for the invitation of a Phase II proposal. Phase II is the prototype/demonstration of the technology that was found feasible in Phase I. Only those successful Phase I efforts that are **invited** to submit a Phase II proposal will be eligible to submit a Phase II proposal. MDA does encourage, but does not require, partnership and outside investment as part of discussions with MDA sponsors for potential Phase II invitation. Invitations to submit a Phase II proposal will be made by the MDA SBIR/STTR PMO.

Please Note: You may only propose up to the total cost for which you are invited. Contract structure for the Phase II contract is at the discretion of the contracting officer after negotiations with the small business.

The MDA SBIR/STTR PMO does not provide "debriefs" for firms who were not invited to submit a Phase II proposal.

PHASE II PROPOSAL SUBMISSION

Eligible firms should follow the Phase II proposal instructions described in Section 3.0 of the program solicitation and specific instructions provided in the Phase II invitation. Invitations for Phase II proposals are generally issued at or near the Phase I contract completion, with the Phase II proposals generally due one month later. In accordance with SBA policy, MDA reserves the right to negotiate mutually acceptable Phase II proposal submission dates with individual Phase I awardees, accomplish proposal reviews expeditiously, and proceed with Phase II awards. If you have been invited to submit a Phase II proposal, please see the MDA SBIR/STTR Web site http://www.mdasbir.com for further instructions.

MDA FAST TRACK DATES AND REQUIREMENTS

Introduction: For more detailed information and guidance regarding the DoD Fast Track Program, please refer to Section 4.5 of the solicitation and the Web site links provide there. MDA's Phase II Fast Track Program is focused on transition of technology. The Fast Track Program provides matching SBIR/STTR funds to eligible firms that attract investment funds from a DoD acquisition program, a non-SBIR/non-STTR government program or private sector investments. Phase II awards under Fast Track will be for $1.0M maximum, unless specified by the Director MDA SBIR/STTR Program.

- For companies that have never received a Phase II SBIR award from DoD or any other federal agency, the minimum matching rate is 25 cents for every SBIR dollar. (For example, if such a company receives interim and Phase II SBIR funding that totals $1,000,000, it must obtain matching funds from the investor of $250,000.)
- For all other companies, the minimum matching rate is 1 dollar for every SBIR dollar. (For example, if such a company receives interim and Phase II SBIR funding that totals $1,000,000, it must obtain matching funds from the investor of $1,000,000.)

Submission: The complete Fast Track application along with completed transition questions (see note below) must be received by MDA within 120 days from the Phase I award date. Your complete Phase II proposal must be received by MDA within 30 days of receiving approval (see section entitled "Application Assessments" herein for further information). Any Fast Track applications or proposals not meeting this deadline may be declined. All Fast Track applications and required information must have a complete electronic submission. The DoD Electronic Submission Web site www.dodsbir.net/submission/SignIn.asp will lead you through the process for submitting your application and technical proposal electronically. Each of these documents is submitted separately through the Web site.

Firms who wish to submit a Fast Track Application to MDA MUST utilize the MDA Fast Track Application Template available at http://www.mdasbir.com (or by writing sbirsttr@mda.mil). <u>Failure to follow these instructions may result in automatic rejection of your application.</u>

Firms who have applied for Fast Track and are not selected may still be eligible to compete for a regular Phase II in the MDA SBIR/STTR Program.

Current guidance and instructions may be found at http://www.mdasbir.com.

MDA SBIR/STTR PHASE II TRANSITION PROGRAM

Introduction: To encourage transition of SBIR and STTR projects into the BMDS, the MDA's Phase II Transition Program provides matching SBIR and STTR funds to expand an existing Phase II contract that attracts investment funds from a DoD acquisition program, a non-SBIR/non-STTR government program or private sector investments. The Phase II Transition Program allows for an existing Phase II SBIR or STTR contract to be extended for up to one year per Phase II Transition application, to perform additional research and development. Phase II Transition matching funds will be provided on a one-for-one basis up to a maximum amount of $500,000 of SBIR or STTR funds in accordance with DoD Phase II Enhancement policy at Section 4.6 of the DoD Solicitation. Phase II Transition funding can only be applied to an active DoD Phase II SBIR or STTR contract.

The funds provided by the DoD acquisition program or a non-SBIR/non-STTR government program may be obligated on the Phase II contract as a modification prior to or concurrent with the modification adding MDA SBIR or STTR funds, OR may be obligated under a separate contract. Private sector funds must be from an "outside investor" which may include such entities as another company or an investor. It does not include the owners or family members, or affiliates of the small business (13 CFR 121.103).

Background: It is important that all technology development programs in MDA map to a BMDS improvement and, after a period of development and maturity, are transitionable to targeted BMDS end users. End users are defined as the element, component or product manager to which it is intended to transition the technology. Because of this, it is important that the Phase II contract be at or approaching a Technology Readiness Level of either 5 or 6.

Current guidance and instructions may be found at http://www.mdasbir.com.

2012 SBIR 12.3 PHASE I KEY DATES (PROJECTION)

12.3 Solicitation Pre-release…………………………………..……......…July 26 – August 26, 2012
12.3 Solicitation Opens ………………………………...……………..August 27 – September 26, 2012
Phase I Evaluations………………………………….……………… October-November 2012*
Selection and Non-Selection Notifications Distributed.……………… December 2012*
Contract Award Goal…………...…………………..…… …………....February 2013*

The Phase II Transition Program Solicitation is ***generally*** announced via http://www.mdasbir.com in the Spring timeframe.

*This information is listed for GENERAL REFERENCE ONLY at the time of publication of this solicitation. This date is subject to update/change.

MDA SBIR 12.3 Topic Index

MDA12-028	Improved Target Discrimination of Multiple Targets Using Bulk Filtering for Debris
MDA12-029	Anchoring Post-Intercept Debris Prediction Tools
MDA12-030	Detailed Lethality Assessments for Flight Test Events
MDA12-031	Innovative designs for reliable Electro-Explosive Ordnance Devices
MDA12-032	Long-Term Missile Aging Assessment & Reliability Predictions for Polymer Materials and Electronic Parts
MDA12-033	Cost Effective, Reliable Service Life Extension Testing of Ordnance Devices
MDA12-034	Correlation identification and evaluation of new technologies or methodologies to accurately measure inertial movement in a stressing flight environment
MDA12-035	Materials and Life Cycle Sustainability

MDA SBIR 12.3 Topics by Research Area

<u>CR-SN (CR-Radar)</u>

MDA12-028	Improved Target Discrimination of Multiple Targets Using Bulk Filtering for Debris

<u>DEF (DE-Future Capability)</u>

MDA12-029	Anchoring Post-Intercept Debris Prediction Tools
MDA12-030	Detailed Lethality Assessments for Flight Test Events

<u>DP-GMD (GM-Ground-based Midcourse Defense)</u>

MDA12-031	Innovative designs for reliable Electro-Explosive Ordnance Devices
MDA12-032	Long-Term Missile Aging Assessment & Reliability Predictions for Polymer Materials and Electronic Parts
MDA12-033	Cost Effective, Reliable Service Life Extension Testing of Ordnance Devices
MDA12-034	Correlation identification and evaluation of new technologies or methodologies to accurately measure inertial movement in a stressing flight environment

<u>DVR (DV-Advanced Technology)</u>

MDA12-035	Materials and Life Cycle Sustainability

MDA SBIR 12.3 Topic Descriptions

MDA12-028 TITLE: Improved Target Discrimination of Multiple Targets Using Bulk Filtering for Debris

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

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 3.5.b.(7) of the solicitation.

OBJECTIVE: Identify & evaluate data/signal processing techniques and algorithms that will minimize or overcome the system degradation caused by dense threat complexes, consisting of large numbers of uninteresting ballistic objects. The intent of this topic is to develop a Bulk Filtering method where the radar return data for non-threatening objects are de-emphasized, suppressed, or rejected before they are presented to the signal/data processors and tracking software for further acquisition, tracking, or discrimination processing. This proposed topic is a paradigm shift in Bulk Filtering of Debris by rejecting the radar return data at the Detection Level. The expectation is that any final product from this effort will yield improvements in the efficient use of sensor resources and the accuracy of sensor data products. Efficiency is gained by eliminating the resource overhead currently used to process non-threatening objects. Accuracy of the reported data improves by removing the large quantities of non-threatening objects from the RF scene shared with the threatening object. By Bulk Filtering objects at the detection level, the risk that a new detection will be mistakenly correlated and integrated with the track of a threatening object is eliminated, and the degradation in track accuracy due to debris is mitigated.

DESCRIPTION: Ballistic Missile Defense System (BMDS) performance is dependent on efficient acquisition, tracking, and discrimination of threatening objects by disparate and geographically dispersed radars, and other sensors. Reducing the resource overhead necessary to process non threatening objects ultimately improves a sensor's effectiveness and enhances the system probability for a successful intercept. As threat complex numbers, densities and countermeasures increase, it becomes even more important to manage radar resources, and minimize extraneous data. This effort is intended to foster improvements in RF discrimination, debris mitigation and track management capabilities for any, or all, missile defense radars.

Technical areas of interest include, but are not limited to:

• Bulk filtering techniques and limitations using current detection algorithms
• Innovative detection algorithms that identify debris and non-threatening objects that will be excluded from further processing

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

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

PHASE III: Integrate algorithms into the BMDS and demonstrate the improved total capability of the updated system. Partnership with traditional DOD prime-contractors will be pursued as government applications of this technology will produce near term benefits from a successful program.

DUAL USE/COMMERCIALIZATION POTENTIAL: Weather Radar (ability to penetrate debris and look into a storm), Air Traffic Control (ability to reject debris and environmental clutter)

REFERENCES:
1. R. Duda, P. Hart, and D. Stork, "Pattern Classification", 2nd Ed., Wiley Interscience, November, 2000.

2. Jenson, Finn V. Bayesian Networks and Decision Graphs. New York: Springer, 2001.

3. Gilks, W.R., Richardson, S. and Speigelhalter, D.J. Markov Chain Monte Carlo In Practive. Boca Raton: Chapman & Hall, 1996.

4. Neapolitan, Richard E. Learning Bayesian Networks. Upper Saddle River: Prentice Hall, 2004.

5. Martinez, David, et.al., “Wideband Networked Sensors”, MIT Lincoln Labs, http://www.fas.org/spp/military/program/track/martinez.pdf, October 2000.

6. D. Hall and James Llinas, “An Introduction to Multisensor Data Fusion,” Proceedings of the IEEE, 85 (No. 1) 1997.

7. D.C. Cowley and B. Shafai, “Registration in Multi-Sensor Data Fusion and Tracking,” Proceedings of the American Control Conference, June 1993.

8. Y. Bar-Shalom and W.D. Blair, Editors, Multi-Target/Multi-Sensor Tracking: Applications and Advances, Vol. III, Artech House, Norwood, MA, 2000.

9. T. Sakamoto and T. Sato, “A fast Algorithm of 3-dimensional Imaging for Pulsed Radar Systems,” Proceedings IEEE 2004 Antennas and Propagation Society Symposium, Vol. 2, 20-25 June 2004.

10. W. Streilein, et al. “Fused Multi-Sensor Mining for Feature Foundation Data,” Proceeding of Third International Conference of Information Fusion, Vol. 1, 10-13, July 2000.

11. Mike Botts [ed.], OpenGIS® Sensor Model Language (SensorML), OGC 05-086r2. http://www.opengeospatial.org/standards/requests/31.

12. M. Ceruti, “Ontology for Level-One Sensor Fusion and Knowledge Discovery,” 8th European Conference on Principles and Practice of Knowledge Discovery in Databases, Pisa, Italy, 2004.

13. Steve Havens [ed.], OpenGIS® Transducer Markup Language TransducerML), OGC 06-010r2. http://www.opengeospatial.org/standards/requests/33.

14. Russomanno, D.J.; Kothari, C.; Thomas, O. “Sensor ontologies: from shallow to deep models.” System Theory, 2005. SSST '05. Proceedings of the Thirty-Seventh Southeastern Symposium on, Vol., Iss., 20-22 March 2005. Pages: 107- 112

15. Marc D. Bernstein ; Benny J. Sheeks, "Field observations of medium-sized debris from post-burnout solid-fuel rocket motors", http://link.aip.org/link/doi/10.1117/12.293344

16. "NASA’s Three-Dimensional Orbital Debris Evolutionary Model", http://www.orbitaldebris.jsc.nasa.gov/model/evolmodel.html

KEYWORDS: Discrimination, bulk filtering, debris mitigation, statistical inference, Bayesian network, algorithms, feature extraction

MDA12-029 TITLE: Anchoring Post-Intercept Debris Prediction Tools

TECHNOLOGY AREAS: Sensors, Electronics, 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 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop and test techniques for collecting data from hyper-velocity missile intercepts for the anchoring of post-intercept debris (PID) models.

DESCRIPTION: MDA continues to develop models to predict and understand the phenomenology of hyper-velocity missile intercepts. Missile intercept events produce complex debris environments whose morphology and density are a function of several parameters including, but not limited to closing speed, target/interceptor mass, hit point, strike angle, presence/absence of reactive materials (e.g. high explosives), mechanical joints, material characteristics, etc. Due to the vast phase space of potential missile engagements and resulting PID scenes that the BMDS may encounter, it is not possible to fully assess system performance within PID environments through flight tests alone. Flight test assessments of sensor performance must be supplemented through BMDS modeling and simulation that includes accurate realizations of PID scenes.

A variety of PID models exist at various levels of maturity and fidelity. These models range from semi-empirical models such as the Kinetic Impact Debris Distribution (KIDD) model to predictive, finite element models based upon first-principle physics such as Velodyne, Paradyn and Zapotec. Each model, regardless of the methodology employed, must be properly anchored to ensure that it captures the relevant phenomenology at the appropriate level of fidelity.

MDA desires a flight-capable means of anchoring model predictions for post-intercept debris. It is important to capture the debris characteristics necessary to properly model BMDS sensor signatures (RF and EO/IR) and complement existing test data (e.g. Light Gas Gun and Sled Track tests). Although current test data provide good information on debris mass, size and shape, there are limitations in the quality of the debris velocity and rotation rate data. Moreover, there are limitations in test article fidelity (both target and interceptor) and engagement space coverage (relatively low closing speeds). Key debris characteristics that should be captured through the proposed data collection methodology include accurate velocities (translational and rotational), approximate sizes, and accurate temperatures. In situ measurements of temperature and pressure during the impact itself are also desirable.

The proposed system providing the anchoring data must fly along with the flight test article and, as such, must have physical size, telemetry requirements and power constraints consistent with being part of a launch vehicle. In particular, total system weight (sensors, batteries and associated electronics if necessary) should be less than 10 lbs, have an independent power source, and be able to telemeter data independently. The system must also be testable in a ground test configuration. The contractor must demonstrate how these requirements will be met. Additionally, it should be noted that the concept must support integration with a launch vehicle several weeks to months before launch.

PHASE I: Develop a concept for tagging, tracking and characterizing the physical properties of post-intercept debris resulting from hyper-velocity impacts. Debris tag concepts should be evaluated for survivability, telemetry, information content and cost. Proof of concept studies should be carried out via modeling and simulation. Develop a plan for constructing a prototype system in Phase II.

PHASE II: Following the development plan outlined in Phase 1, construct a prototype debris tagging and telemetry system. Verify prototype performance via more extensive high-fidelity modeling and simulation along with ground testing. The system can be tested incrementally evaluating components of the larger system as opposed to a full system-level test.

PHASE III: Mature the prototype via component testing to a system-level test (ground and/or flight). Refine the system design to ensure compatibility with MDA flight test articles using high-fidelity modeling and simulation and data acquired during component/prototype system testing. Initiate integration efforts in support of future MDA flight tests.

COMMERCIALIZATION: The contractor will pursue commercialization of the various technologies developed in Phase II for additional DoD applications. Such applications could include weapons and armor development and insensitive munitions testing where fragmentation and debris generation are of interest. Potential commercial uses include rocket motor safety testing for commercial space flight and NASA.

REFERENCES:

1. Trucano, T.G., "Equation of State and Fragmentation Issues in Computational Lethality Analysis", Sandia Report 92-2397, 1993.

2. Zucas, J. A., "Introduction to Hydrocodes (Studies in Applied Mechanics)", Elsevier, New York, NY, 2004.

3. Doup, P.W., "Endgame Analyses Against a Ballistic Missile: A Parametric Study", TNO Defence, Security and Safety, P.O. Box 96864, 2509 JG The Hague, The Netherlands, Report #DV2 2005-A33, July 2005.

4. Vetrovec, John et. al., "Analysis and Testing of Rod-Like Penetrators in the 4-5 Km/s Velocity Regime", International Journal of Impact Engineering Vol. 26 (2001), pages 797-808.

KEYWORDS: post-intercept debris, debris mitigation, kill assessment

MDA12-030 TITLE: Detailed Lethality Assessments for Flight Test Events

TECHNOLOGY AREAS: Sensors, Electronics, Weapons

ACQUISITION PROGRAM: MDA/DEF

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 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop in situ detectors for MDA flight test targets to directly record physical properties in and around the expected warhead location to provide a more definitive measure of interceptor lethality.

DESCRIPTION: MDA has the responsibility to test new and improved interceptor missiles against new and evolving threats. To accomplish this, MDA must constantly upgrade the capability of missile targets to (1) be more threat representative and (2) provide as much physical information as possible about what happens during the "end game", which is characterized by a time period of no more than 100 microseconds.

The purpose of this topic is to solicit concepts and system designs that will go beyond the establishment of a hit point on a target and will provide useful information on the sequential destructive processes after the initial impact. Classically, hit detectors have been comprised of X/Y grids of sensing elements that when broken by the initial impact yielded a localized first point of impact. Recently techniques have been introduced that utilize impact energies to determine the impact points. The technology solicited here should address the measurement of physical quantities of interest including pressure profiles, deceleration rates, and physical damage progression with an emphasis on characterization of the expected physical location of the warhead.

Whatever the initial technique, this topic solicits designs that can provide more definitive assessments of the actual destructive potential of either a hit-to-kill interceptor or a fragmenting warhead. Proposed systems must be able to address either type of kill vehicle. Cost, weight, power and telemetry are all important considerations in the design of this system. In particular, weight should be kept under 10 lbs, power less than 3A and telemetry must be accommodated through capture of existing telemetry systems during end game.

PHASE I: Through high-fidelity analysis, investigate projected damage production on a representative, unclassified target. The number and type of physical measurements that would be needed to provide improved situational awareness within seconds after the intercept would be investigated and a prototype system designed. The Phase 1 design would also be required to show, by analysis or experiment, that it would satisfy the speed and extreme environmental chaos that dominates a hit-to-kill intercept.

PHASE II: Realize a design of a prototype system that could be included on typical MDA target missiles. Component testing should be conducted to verify modeling and simulation results. Further analysis of the proposed flight test system design should be conducted. Component/sub-system testing using high-velocity impact ranges should be conducted to verify performance

PHASE III: Mature the prototype system toward flight-ready status and integration within MDA flight test articles. Full and sub-scale system tests should be conducted via ground (e.g. light gas gun, sled, etc.) and/or flight tests. Integration with existing MDA flight test articles should be pursued.

COMMERCIALIZATION: The contractor will pursue commercialization of the various technologies developed in Phase II for additional DoD or commercial applications. Such applications could include weapons and armor development testing (i.e. lethality), rocket motor safety testing, and in-flight monitoring of debris or other impact events for satellites and other orbiting spacecraft.

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1. Lloyd, R.M., "Physics of Direct Hit and Near Miss Warhead Technology", Progress in Astronautics and Aeronautics Vol 194, AIAA, 2001.

2. Vetrovec, John et. al., "Analysis and Testing of Rod-Like Penetrators in the 4-5 Km/s Velocity Regime", International Journal of Impact Engineering Vol. 26 (2001), pages 797-808.

3. Doup, P.W., "Endgame Analyses Against a Ballistic Missile: A Parametric Study", TNO Defence, Security and Safety, P.O. Box 96864, 2509 JG The Hague, The Netherlands, Report #DV2 2005-A33, July 2005.

KEYWORDS: hit detection system, hyper-velocity impact, hit-to-kill interceptor, target missile, lethality

MDA12-031 TITLE: Innovative designs for reliable Electro-Explosive Ordnance Devices

TECHNOLOGY AREAS: Electronics, 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 3.5.b.(7) of the solicitation.

OBJECTIVE: This topic seeks to apply innovative concepts from the field of Electro-Explosive Ordnance Devices for use on Interceptors to improve the overall reliability and lower the failure and/or inadvertent initiation risks by simplifying the design, employing contemporary or next generation energetics, or incorporating other robust features to lower risks and enhance reliability.

DESCRIPTION: Electro-Explosive Ordnance Devices (EEDs) are used in Interceptor as mission critical components. These "one-shot" devices must be reliable and function when needed after extended periods of storage. While numerous designs exist in industry, concepts that would enhance reliability, producibility, and testability are needed. Recent producibility problems with existing EEDs have created enhanced awareness of the need for improvements. Further, a means to allow for some health monitoring through "built-in-test" would be a significant breakthrough.

The successful bidders for this effort shall be provided with generic interface and general performance requirements of typical Interceptor EEDs. General storage and functional environments will also be provided. For various applications of interest the thermal environments are not severe.

Proposals need to demonstrate an innovative concept that has a realistic potential to enhance EED reliability through robust design and/or manufacturing techniques. Reliability enhancements in explosive materials, bridge-wire materials, or other EED component materials are sought. Designs that enhance robustness in No-Fire tests are of particular interest.

PHASE I: Mature the proposed EED design concept to fully document the feasibility of the enhancements for reliability, producibility, and/or testability. During this phase the enhanced concepts may be tailored to the generic interface and performance requirements of interest for Interceptor EEDs.

PHASE II: Demonstrate the feasibility of the enhanced reliability EED design by building and testing proto-type units. This phase will focus on verifying that the proposed enhancements will actually increase reliability of the EED, thus the scope of this phase will be tailored to highlight the benefits of the specific design. For this phase, proposers are encouraged to indentify a partnership with a current or potential supplier that has appropriate manufacturing capabilities to produce the EEDs.

PHASE III: Integrate the enhanced reliability EED into a critical Interceptor application and generalize the application for broader applications across MDA programs and commercially. This phase will demonstrate the applicability in one or more MDA element systems, subsystems, or components.

DUAL USE/COMMERCIALIZATION POTENTIAL: The proposal should clearly show that the enhanced reliability EED has benefits to both commercial and defense applications. The projected benefits to reduce cost, improved reliability, improved testability, or improved producibility should be made clear. The demand for highly reliable electro-explosive ordnance devices is a multi-million dollar, world-wide market with demands in diverse areas such as: military warheads, aircraft ejection seats, precision mining, precision controlled demolitions, launch vehicles, and spacecraft applications. Success in this research area should strengthen available reliable EED hardware for use at MDA, other DoD Agencies, and commercial entities.

REFERENCES:
1. MIL-STD-1512, MILITARY STANDARD: ELECTROEXPLOSIVE SUBSYSTEMS

2. MIL-STD-1576, MILITARY STANDARD: ELECTROEXPLOSIVE SUBSYSTEM SAFETY REQUIREMENTS AND TEST METHODS FOR SPACE SYSTEMS (31 JUL 1984)

3. AIAA-S-113-2005, Criteria for Explosive Systems and Devices on Space and Launch Vehicles (Nov. 2005)

4. MIL-STD-1760 Aircraft/Store Electrical Interconnection System

KEYWORDS: Electro-Explosive, Explosive, Ordnance, Squibs, Pyrotechnics, Energetics, Propellants, Blasting Caps, Multi-point Initiators, Electro-mechanical Safe & Arm Device, Exploding Bridgewire Detonator

MDA12-032 TITLE: Long-Term Missile Aging Assessment & Reliability Predictions for Polymer Materials and Electronic Parts

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 3.5.b.(7) of the solicitation.

OBJECTIVE: The development of innovative methodologies, components, or subsystems that aide in long term reliability assessment of missile hardware. Methodologies are sought using the latest proven systematic approaches to age acceleration testing of typical missile and payload components that are maintained in inert modes for extended periods of time prior to launch. Further, advanced reliability assessment techniques are desired to complement the acceleration aging methodologies for application to these components.

DESCRIPTION: The Missile Defense Agency is seeking technologies to support its Stockpile Reliability Program. These technologies must aid in the determination and prediction of system failures or potential failures. One method used to develop information on shelf life of systems, subsystems and parts is accelerated aging testing. This method also documents system status and predicts expiration dates of subsystems and parts. Accelerated aging is a testing method used to estimate the useful lifespan of a product when actual lifespan data is unavailable. This occurs with products that have not existed long enough to have gone through their useful lifespan. Real time aging must be performed in conjunction with any accelerated aging study to correlate the results found during accelerated aging.

Missile components may contain polymer materials that are age sensitive and stay in a dormant state for extended periods of time prior to use. Thus, elevated temperature aging is often used to accelerate chemical breakdown. Other industries, such as medical products and packing, have developed advanced techniques for accelerated life testing that may be applicable to aerospace missile and payload materials. An example of areas where advances are sought is in techniques for applying the Arrhenius time-temperature superposition equation to components with multiple age sensitive polymeric materials.

Other areas where advances are sought using accelerated aging are in electronic parts and printed circuit boards (PCBs). Electronic parts normally fail because of expected and predictable wear-out mechanisms. These most often are metal failures over time, oxide failures due to electrical stress, or issues associated with packaging techniques. Techniques are needed to age such components at a greatly accelerated rate while still accurately reflecting “natural” aging (aging under typical use). Techniques to accurately measure degradation of parts and assess reliability are also needed.

The theory of reliability assessment has greatly advanced in the past few years. The results of these theoretical advancements could be utilized to enhance methods used to predict potential failures of MDA missile stockpiles and other weapons. This theory coupled with the use of advances in accelerated aging testing could be used to provide an enhanced, robust methodology for predicting weapon stockpile reliability.

PHASE I (Feasibility): Research previous uses of and recent developments in age acceleration testing and advanced reliability assessment. Research should cover applications in missile technologies and other fields whose methods may be pertinent to missiles and payloads. Determine which specific technologies, methods and techniques have the greatest potential to improve fault prediction/detection and general reliability of missiles in long-term storage. Focus should be on proven (not necessarily in missiles) and cost-effective solutions that couple age acceleration and advanced reliability assessment.

PHASE II (R&D + Prototype): Based on the results/findings of phase I, develop a complete approach to long-term reliability assessment by combining the best cost-effective technologies, methods, and techniques in age-acceleration testing and advanced reliability assessment. Demonstrate the methodology and techniques using a complex missile or payload component for verification of the approach. Robustness should be demonstrated by verification with naturally aged components and possibly with use of other materials/components.

PHASE III (Commercial Development): Verify overall approach and finalize the methodology. The proposed methodology developed under this effort should advance the state-of-the-art in cost effective long-term reliability assessment, shelf life estimates, preventative and other maintenance. Demonstrate commercial scalability of the technology for use in commercial product development, reliability assessment and shelf life estimates.

DUAL USE/COMMERCIALIZATION POTENTIAL: Demonstrate the commercial prospects of this technology through utilization of the methodology on development of complex commercial product/process. The envisioned solutions to this effort will have applications in both military and non-military markets to include commercial aircraft, satellite, and others markets. The military applications include various missile systems, satellites, and UAVs.

REFERENCES:

1) "HALT, HASS & HASA Explained, Accelerated Reliability Techniques, Revised Edition" by Harry W. McLean, ASQ ISBN 978-0-87389-766-2.

2) "Management & Technical Guidelines for the ESS Process" IEST-RP-PR001.1, published by the Institute of Environmental Sciences and Technology.

3) "Accelerated Testing" a Practitioners Guide to Accelerated and Reliability Testing, by Bryan Dodson and Harry Schwab.

4) "Accelerated Reliability Engineering", by Gregg Hobbs, ISBN 0-615-12833-5.

5) http://www.mda.mil/global/documents/pdf/GMD_DSC_Focused_Transition_brief.pdf

6) http://www.spacewar.com/reports/Lockheed_Martin_Provides_Proven_Solutions_For_Missile_Defense_999.html

7) "Ballistic Missile Defense Review," Office of the U. S. Secretary of Defense, February 2010. Available via internet at http://www.defense.gov/bmdr/.

KEYWORDS: accelerated aging, stockpile reliability, shelf life estimates, service life predictions, sensors

MDA12-033 TITLE: Cost Effective, Reliable Service Life Extension Testing of Ordnance Devices

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 3.5.b.(7) of the solicitation.

OBJECTIVE: Assess viable approaches to cost effective, reliable service life extension testing of ordnance devices. Investigate the various approaches used in industry to conduct service life extension testing and develop reliable testing solutions specific to ordnance devices. Maintaining fielded systems beyond their original design life provides potential cost-savings for the Missile Defense Agency.

DESCRIPTION: The Missile Defense Agency is seeking technologies to support its Stockpile Reliability Program. Interceptors must function successfully after being exposed to lengthy periods of environmental exposure. Interceptor ordnance devices, referred to as “one-shot” devices, include, but are not limited to, solid rocket motors, mild detonating fuses, pressure cartridges, frangible devices, and hot gas generators. Other types of explosive devices can be found in MIL-HDBK-83578. Interceptor “one-shot” devices cannot be exposed to any “health monitoring, Built-In-Tests” like electronic components to ensure readiness, making other means of verification critical. Service Life Extension (SLE) testing on units is performed to extend the service time beyond the original design life of ordnance devices and is typically used to assess readiness of units installed on interceptors. Various approaches are used for SLE testing throughout industry with some including high temperature accelerated aging and function testing of aged components. Although the specific component design may have satisfied all material compatibility tests and analysis, subtle lot-to-lot manufacturing and processing variations may have adverse effects on a particular production lot of units. Arbitrary SLE times are used for different testing and ordnance device components which may prove to be costly and ineffective, thus, a focused effort to develop a technically sound, cost-effective means to grant SLE is desired. Reliability of ordnance devices is critical to Interceptor mission success, thus warranting development of a rigorous, cost-effective approach to this testing.

While recommended SLE testing approaches for Lots are defined Military and AIAA Standards, they are based on assumptions of linear relationships between test duration and life extension, test quantities required for life extension, and other assumptions. Proposals should address a systematic, technically sound approach to developing a cost-effective SLE approach across various ordnance device components.

PHASE I: Development of a thorough assessment of best practices used in industry for Service Life Extension of ordnance devices, recommend a cost-effective approach that includes test methodologies and appropriate analysis tools that facilitate Service Life assessment.

PHASE II: Based on the results/findings of Phase I, develop analysis tools and potentially apply processes to Government Furnished Equipment (GFE) for validation over an extended period. This phase would proto-type the process and analysis tools.

PHASE III: Verification of overall approach and finalize the methodology. The proposed methodology developed under this effort should advance the state-of-the-art in cost effective service life extension testing of ordnance devices to enhance predicted and demonstrated reliability. This phase may include refinement of analytical tools for SLE assessment, and implementation of the testing process as an MDA Standard on various Interceptor Programs. Further, this phase should include demonstration of commercial scalability of the technology for use in commercial product development, reliability assessment and service life estimates.

DUAL USE/COMMERCIALIZATION POTENTIAL: The proposer should demonstrate the commercial prospects of this technology through utilization of the methodology on development of complex commercial product. The envisioned solutions to this effort will have applications in both military and non-military markets to include commercial aircraft and satellite markets, and others. The military applications include various missile systems, satellites, and UAVs.

REFERENCES:
1) "HALT, HASS & HASA Explained, Accelerated Reliability Techniques, Revised Edition" by Harry W.McLean, ASQ ISBN 978-0-87389-766-2.

2) "Management & Technical Guidelines for the ESS Process" IEST-RP-PR001.1, published by the Institute of Environmental Sciences and Technology.

3) "Accelerated Testing" a Practitioners Guide to Accelerated and Reliability Testing, by Bryan Dodson and Harry Schwab.

4) "Accelerated Reliability Engineering", by Gregg Hobbs, ISBN 0-615-12833-5.

5) http://www.mda.mil/global/documents/pdf/GMD_DSC_Focused_Transition_brief.pdf

6) http://www.spacewar.com/reports/Lockheed_Martin_Provides_Proven_Solutions_For_Missile_Defense_999.html

7) "Ballistic Missile Defense Review," Office of the U. S. Secretary of Defense, February 2010. Available via Internet at http://www.defense.gov/bmdr/.

8) MIL-STD-1512, MILITARY STANDARD: ELECTROEXPLOSIVE SUBSYSTEMS

9) MIL-STD-1576, MILITARY STANDARD: ELECTROEXPLOSIVE SUBSYSTEM SAFETY REQUIREMENTS AND TEST METHODS FOR SPACE SYSTEMS (31 JUL 1984)

10) AIAA-S-113-2005, Criteria for Explosive Systems and Devices on Space and Launch Vehicles (Nov. 2005)

11) MIL-HDBK-83578 (USAF), Criteria for Explosive Systems and Devices Used on Space Vehicles (Jan. 1999)

KEYWORDS: Accelerated aging, stockpile reliability, shelf life estimates, service life predictions, service life extension tests, sensors

MDA12-034 TITLE: Correlation identification and evaluation of new technologies or methodologies to accurately measure inertial movement in a stressing flight environment

TECHNOLOGY AREAS: Air Platform, Electronics, Space Platforms, 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 3.5.b.(7) of the solicitation.

OBJECTIVE: This topic seeks to identify and evaluate new technologies that accurately measure inertial movement in a stressing flight environment. Fiber Optical Gyroscope (FOG) technology is currently used to measure inertial movement in many flight hardware applications, but is expensive, relatively large, and has performance limitations in certain environments. Typical stressors include "g" forces during acceleration, vibrations from mechanical component of air vehicles, and high/low temperatures experienced during flight. The objective of this research is to identify affordable new technologies and assess them for suitability during flight environment (shock, vibration, temperature, pressure/vacuum, etc.). Associated component design considerations of electronics of identified technologies, such as Printed Wiring Assembly (PWA) thickness, materials of construction, numbers of layers, vibration resonance mitigations, or other variables, should be evaluated in concert for each identified technology.

DESCRIPTION: Accurate inertial measurement of military flight vehicles is critical for many weapon systems and flight hardware. These vehicles experience stressing environments (shock, vibration, high/low temperatures, and pressure/vacuum) during their mission. GM has a need for the capability for accurate inertial measurement in a flight environment, including vibration environments to at least 100 Khz.

PHASE I: Identify and assess feasibility of alternate technologies for IMU. Assess preliminary development of innovative design concepts that utilize these technologies.

PHASE II: Develop prototype IMU for proof of concept testing. Develop the software tools, algorithms and a methodology to complete a design(s) and provide a technology demonstration in an environmental test laboratory.

PHASE III: A successful transition candidate would be evaluated for stability of design and repeatable production. Production representative IMUs would be produced and proven in a laboratory environment.

COMMERCIALIZATION: The proposal should clearly show that the new IMU technology has benefits to both commercial and defense applications. The projected benefits to reduce cost, improved reliability, improved testability, or improved producibility should be made clear. The demand for highly reliable inertial measurement devices is a multi-million dollar, world-wide market with demands in diverse areas such as: military weapons, aircraft guidance, gaming systems, cellular telephones, and spacecraft applications. Success in this research area should strengthen available reliable IMU hardware for use at MDA, other DoD Agencies, and commercial entities.

REFERENCES:
1. Epson IMU melds precision, low-cost; R. Colin Johnson, 6/6/2011, "EE Times".

2. MIL-STD 1540E, Test Requirements for Launch, Upper-Stage and Space Vehicles. TR-2004(8583)-1, Rev A, Released Sept 6, 2006.

KEYWORDS: Inertial Measurement, Stressing Environments, Shock, Vibration, Software Tools, Algorithm

MDA12-035 TITLE: Materials and Life Cycle Sustainability

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: MDA/DVR

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 3.5.b.(7) of the solicitation.

OBJECTIVE: Enhance the performance, producibility, and sustainability of missile body structures and components for implementation into Ballistic Missile Defense (BMD) systems primarily through utilization of novel materials and processes. Provide materials solutions to reduce procurement cost, lower life cycle cost, lower operational maintenance, reduce lead time, enhance mission reliability and improve manufacturability for low-rate, non-labor intensive production for BMD systems.

DESCRIPTION: MDA is seeking high-performance materials and process technologies for enhancement of current and block upgraded missile defense systems. These endo-atmospheric and exo-atmospheric intercept systems are highly complex missile systems. Incorporating existing and novel materials and process technologies offer a significant potential for enhancing performance properties while improving the producibility and sustainability of these structures. Process technologies should be appropriate for modest production volumes; incorporate modularity, flexibility, simplified and/or low-cost tooling; and be consistent with Lean and Six Sigma methodologies. The focus of this topic is for the missile body, launch canister, and kill vehicle structures or components, excluding propulsion systems. Clarifying kill vehicle materials need outside of propulsion technologies, interest include materials that dampen inherent shock and vibrations experienced during system operation. Additional materials of interest for kill vehicles are those functioning to increase structural survivability from environmental, mechanical, and operational effects.

Technical areas of interest include, but are not limited to:

Material Life Cycle and Sustainability: Missile and light weight palletized containment systems must address issues involving extended lifetimes with cyclic operational and life cycle loads. Addressing issues associated with these environments are key to maintaining robust capabilities in terms of both flight vehicle and containment system readiness. Environments of interest include, but are not limited to, moisture absorption/associated failure modes, material out-gassing, plume effects (temp/erosion), transportation cyclic loads (combined environment), and UV response. The capability to assess health and condition of material systems in these environments will be important. Solutions address such issues as limiting or blocking moisture absorption through barriers/coatings or the material system matrix/fiber system type employed, as well as creating material systems that are less prone to debilitating effects from this (i.e. delaminating). The benefits include improved health of internal electronic systems, propellants, and optics. Other metrics include strength and durability under combined temperature and cyclic mechanical loads. Advanced or improved testing methods for quickly and efficiently characterizing these metrics are also of interest.

Aerostructures: Advanced missile defense interceptors require aero-structures designed to survive harsh operational and long term storage environments. In addition, evolving threat dynamics and proliferation underscore the need to increase system performance while reducing cost per kill. As related to aero-structures the following three (3) goals can be used to focus development efforts related to topic and to serve as overarching requirements:

(1) Maximize interceptor performance and long term storage.

(2) Minimize interceptor cost.

(3) Ensure interceptor radiation survivability and structural integrity during flight.

Advanced missile defense interceptors require lightweight thermal protection systems (TPS), radomes and aerostructures designed to minimize internal temperature rise and ensure missile airframe structural integrity during flight, including operation in adverse weather. These systems must meet a variety of requirements such as weight, erosion/ablation performance, and cost.

Clearly the flow-down of the requirements listed above indicate the desire to have material systems that are lower mass, higher strength/stiffness, and tailorable thermal conductivity to allow advanced thermal management schemes due to longer flight times within the atmosphere. In addition, the long term storage requirement flow-down dictate material systems that minimize out-gassing and water permeability over time. Interceptor cost drivers span many different aspects to include schemes to reduce/streamline composite manufacturing tooling cost and process controls.

Preliminary material suitability metrics include:

a. Cold wall heating rates of 50-400 Btu/ft2-s

b. Shear rates of 10-50 psf

c. Operating temperature range of 2500-6000F

d. Survive weather encounter

e. Lightening Strike protection

f. HANES Standard

Weather Encounter: Advanced missile interceptors have the potential for encountering adverse weather conditions during flight. As a result, there is a need to enhance the producibility, operability and survivability of various missiles and missile components for operation in adverse environments. Adverse weather conditions may include natural events such as rain, snow, ice, gravel, sand/dust, or catastrophic naturally occurring weather events such as volcanic particulates. Typical velocity regimes are in the range of subsonic through high supersonic. Current needs include: analytic tool development, new or improved ground and flight testing methodologies, facility environment characterizations, and improvements in single impact and sled testing methods for all hydrometeor and solid particulate types. Included in this topic are also novel low-cost testing methods that can use subscale rockets and innovative instrumentation, recession gauges, or material samples to record impact events during flight.

PHASE I: Conduct experimental and/or analytical efforts to demonstrate proof-of-principle and to improve producibility, increase performance, lower cost, or increase reliability. Explore the concept and develop novel processes for fabrication and utilization of selected missile components. If applicable, produce test coupons of the materials and measure relevant properties. Assess the fabrication cost and impacts on service methods, safety, reliability, sustainability and efficiency. Perform a preliminary manufacturability and cost benefit analysis showing that the structure can be produced in reasonable quantities and at reasonable cost/yields, based on quantifiable benefits, by employing techniques suitable for scale up. Conduct weather environment characterization, develop/validate physics based numerical models of vehicle flowfield/weather coupling, develop material impact models, and develop/modify test evaluation methodologies for all aspects of weather encounter phenomena.

PHASE II: Based on the results and findings of Phase I, demonstrate the technology by fabricating and testing a prototype in a representative environment. Demonstrate feasibility and engineering scale up of proposed technology and 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. Demonstrate scalable manufacturing technology during production of the articles. Identify and assess commercial applications of the material or process technology.

PHASE III: Demonstrate new open/modular, non-proprietary materials and/or structures technology. Provide a potentially qualifiable design for an innovative structure that will provide for advancement of the state-of-the-art in aerospace and missile structure performance, safety, weather robustness, life extension, preventative and other maintenance. Demonstrate commercial scalability of the manufacturing process and the implementation of the software-based design tools for the commercial development and deployment of advanced structures and radomes. Commercialize the technology for both military and civilian applications. Demonstration should be in a real system or operational in a system level test-bed.

DUAL USE/COMMERCIALIZATION POTENTIAL: The proposed technology should benefit commercial and defense manufacturing through cost reduction, improved reliability and sustainment, or enhanced producibility and performance.

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1. Deason, D.M., Missile Defense Materials & Manufacturing Technology Program, ASM Annual Meeting, Columbus, OH, Oct. 2003.

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7. Lindsay, J. and O'Hanlon, M.E., Defending America: The Case for Limited National Missile Defense, Brookings Institute Press, Apr. 2001.

8. Moylan, B., and Russell, G., "Updating Mil-Std-810 to Address High-Speed Weather Encounter Testing", 53rd Annual Technical Meeting of the Institute of Environmental Sciences and Technology. April 29-May2, 2007.

9. Moylan, B., "Enhanced Testing Methods to Assess Weather Environmental Impacts on High-Speed Vehicle Designs", 53rd Annual Technical Meeting of the Institute of Environmental Sciences and Technology. April 29-May 2, 2007.

10. Robust Kill Vehicle Design Using Tailorable Material Systems," Laddin Montgomery, Aero Thermo Technology, Inc., Huntsville, AL; Proceedings from National Space and Missile Materials Symposium – 23 June 2008.

11. Effects of Coatings on Moisture Absorption in Composite Materials," James R. Newill; Steven H. McKnight; Christopher P. Hoppel; Gene R. Cooper; Army Research Lab, Aberdeen Proving Ground, MD; October 1999; Report Number: A305273.

KEYWORDS: Missiles, Hybrid Composite, Thermal Control, Thermal Insulation, Advanced Materials, Lightweight, Radomes