NASA SBIR 2014 Phase I Solicitation

H13 Non-Destructive Evaluation

Future manned space missions will require technologies that enable detection and monitoring of the space flight vehicles during deep space missions. Development of these systems will also benefit the safety of current missions such as the International Space Station and Aerospace as a whole. Technologies sought under this SBIR Topic can be defined as advanced sensors, sensor systems, sensor techniques or software that enhance or expand NASA's Nondestructive Evaluation (NDE) and Structural Health Monitoring (SHM) capability beyond the current State of the Art. Sensors and Sensor systems sought under this topic can include but are not limited to techniques that include the development of quantum, meta- and nano sensor technologies for deployment. Technologies enabling the ability to perform inspections on large complex structures will be encouraged. Technologies should provide reliable assessments of the location and extent of damage. Advanced processing and displays are needed to reduce the complexity of operations for astronaut crews who need to make important assessments quickly. Examples of structural components that will require sensor and sensor systems are multi-wall pressure vessels, batteries, thermal tile, thermal blankets, micrometeoroid shielding, International Space Station (ISS) Radiators or aerospace structural components. SHM technologies and integrated vehicle health management (IVHM) systems and analysis tools can include both active and passive SHM systems. Techniques sought include modular/low mass-volume systems, low power, low maintenance systems, and systems that reduce or eliminate wiring, as well as stand-alone smart-sensor systems that provide processed data as close to the sensor as practical and systems that are flexible in their applicability. Damage detection modes include leak detection, ammonia detection, micrometeoroid impact and others. Reduction in the complexity of standard wires and connectors and enabling sensing functions in locations not normally accessible with previous technologies is also desirable. Examples of space flight hardware will include light weight structural materials including composites and thin metals. Consideration will be given to the all system ability operate and survive in on-orbit and deep space.

Subtopics

H13.01 Advanced NDE Techniques for Complex Built Up Structures

Lead Center: LaRC

Participating Center(s): AFRC, GRC, GSFC, JSC, MSFC

Technologies sought under this SBIR program can be defined as advanced sensors, sensor systems, sensor techniques or software that enhance or expand NASA's current senor capability. It is considered to be advantageous but not necessary to target structural components of space flight hardware. In a general sense space flight hardware will include light weight structural materials including composites and thin metals.

Technologies sought include modular smart advanced NDE sensors systems and associated capture and analysis software. It is advantageous for techniques to include the development on quantum, meta- and nano sensor technologies for deployment. Technologies enabling the ability to perform inspections on large complex structures will be encouraged. Technologies should provide reliable assessments of the location and extent of damage. Methods are desired to perform inspections in areas with difficult access in pressurized habitable compartments and external environments for flight hardware. Many applications require the ability to see through assembled conductive and/or thermal insulating materials without contacting the surface. Techniques that can dynamically and accurately determine position and orientation of the NDE sensor are needed to automatically register NDE results to precise locations on the structure. Advanced processing and displays are needed to reduce the complexity of operations for astronaut crews who need make important assessments quickly. NDE inspection sensors are needed for potential use on free-flying inspection platforms. Integration of wireless systems with NDE may be of significant utility. It is strongly encouraged to provide explanation of how proposed techniques and sensors will be applied to a complex structure. Examples of structural components include but are not limited to multi-wall pressure vessels, batteries, tile, thermal blankets, micrometeoroid shielding, International Space Station (ISS) Radiators or other aerospace structural components.

Phase I Deliverables - Lab prototype, feasibility study or software package including applicable data or observation of a measureable phenomena on which the prototype will be built. Inclusion of a proposed approach to develop a given methodology to Technology Readiness Level (TRL) of 2-4. All Phase I’s will include minimum of short description for Phase II prototype. It will be highly favorable to include description of how the Phase II prototype or methodology will be applied to structures.

Phase II Deliverables - Working prototype or software of proposed product, along with full report of development and test results. Prototype or software of proposed product should be of Technology Readiness Level (TRL 5-6). Proposal should include plan of how to apply prototype or software on applicable structure or material system. Opportunities and plans should also be identified and summarized for potential commercialization.

H13.02 Advanced Structural Health Monitoring

Lead Center: LaRC

Participating Center(s): AFRC, ARC, GRC, GSFC, JSC, MSFC

Future manned space missions will require spacecraft and launch vehicles that are capable of monitoring the structural health of the vehicle and diagnosing and reporting any degradation in vehicle capability. This subtopic seeks new and innovative technologies in structural health monitoring (SHM) and integrated vehicle health management (IVHM) systems and analysis tools.

Techniques sought include modular/low mass-volume systems, low power, low maintenance systems, and systems that reduce or eliminate wiring, as well as stand-alone smart-sensor systems that provide processed data as close to the sensor as practical and systems that are flexible in their applicability. Examples of possible system are: Surface Acoustic Wave (SAW)-based sensors, passive wireless sensor-tags, flexible sensors for highly curved surfaces direct-write film sensors, and others. Damage detection modes include leak detection, ammonia detection, micrometeoroid impact and others. Reduction in the complexity of standard wires and connectors and enabling sensing functions in locations not normally accessible with previous technologies is also desirable. Proposed techniques should be capable of long term service with little or no intervention. Sensor systems should be capable of identifying material state awareness and distinguish aging related phenomena and damage related conditions. It is considered advantageous that these systems perform characterization of age-related degradation in complex composite and metallic materials. Measurement techniques and analysis methods related to quantifying material thermal properties, elastic properties, density, microcrack formation, fiber buckling and breakage, etc. in complex composite material systems, adhesively bonded/built-up and/or polymer-matrix composite sandwich structures are of particular interest. Some consideration will be given to the IVHM /SHM ability to survive in on-orbit and deep space conditions, allow for additions or changes in instrumentation late in the design/development process and enable relocation or upgrade on orbit. System should allow NASA to gain insight into performance and safety of NASA vehicles as well as commercial launchers, vehicles and payloads supporting NASA missions. Inclusion of a plan for detailed technical operation and deployment is highly favored.

Phase I Deliverables - Lab prototype or feasibility study, including simulations and measurements, proving the proposed approach to develop a given product (TRL 2-4). Plan for Phase II including proposed verification methods.

Phase II Deliverables - Working engineering model or software of proposed product, along with full report of development and test results, including verification methods (TRL 5-6). Opportunities and plans should also be identified and summarized for potential commercialization.