



NASA SBIR 2017 Phase I Solicitation

Z11.02 NDE Simulation and Analysis

Lead Center: LaRC

Participating Center(s): ARC, JSC

Technology Area: TA12 Materials, Structures, Mechanical Systems and Manufacturing

Technologies sought under this subtopic include near real-time large scale nondestructive evaluation (NDE) and structural health monitoring (SHM) simulations and automated data reduction/analysis methods for large data sets. Simulations techniques will seek to expand NASA's use of physics based models to predict inspection coverage for complex aerospace components and structures. Analysis techniques should include optimized automated reduction of NDE/SHM data for enhanced interpretation appropriate for detection/characterization of critical flaws in space flight structures and components. Space flight structures will include light weight structural materials such as composites and thin metals. Future purposes will include application to long duration space vehicles, as well as validation of SHM systems. It is also considered highly desirable to develop tools for automating detection of material Foreign Object Debris (FOD) and/or defects and evaluation of bondline and in-depth integrity for light-weight rigid and/or flexible ablative materials are sought. Typical internal void volume detection requirements for ablative materials are on the order of less than 6mm and bondline defect detection requirements are less than 25mm.

Techniques sought include advanced material-energy interaction (i.e., NDE) simulations for high-strength lightweight material systems and include energy interaction with realistic damage types in complex 3D component geometries (such as bonded/built-up structures). Primary material systems can include metals but it is highly desirable to target composite structures and/or thermal protection systems. NDE/SHM techniques for simulation can include ultrasonic, laser, Micro-wave, Terahertz, Infra-red, X-ray, X-ray Computed Tomography, Fiber Optic, backscatter X-Ray and eddy current. It is assumed that any data analysis methods will be focused on NDE techniques with high resolution high volume data. Modeling efforts should be physics based and it is desired they can account for material aging characteristics and induced damage, such as micrometeoroid impact. Examples of damage states of interest include delamination, microcracking, porosity, fiber breakage. Techniques sought for data reduction/interpretation will yield automated and accurate results to improve quantitative data interpretation to reduce large amounts of NDE/SHM data into a meaningful characterization of the structure. Realistic computational methods for validating SHM systems are also desirable. It is advantageous to use co-processor configurations for simulation and data reduction. Co-Processor configurations can include graphics processing units (GPU), system on a chip (SOC), field-programmable gate array (FPGA) and Intel's Many Integrated Core (MIC) Architecture. Combined simulation and data reduction/interpretation techniques should demonstrate ability to guide the development of optimized NDE/SHM techniques, lead to improved inspection coverage predictions, and yield quantitative data interpretation for damage characterization.

Phase I Deliverables - Feasibility study, including demonstration simulations and data interpretation algorithms, proving the proposed approach to develop a given product (TRL 2-4). Plan for Phase II including proposed verification methods.

Phase II Deliverables - 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.

Potential NASA Customers include:

- Space exploration missions such as missions to Asteroids, Mars or various Earth-Moon Liberation Waypoints.
- International Space Station.

For proposers with an interest in the sensors used in NDE, please see Subtopic Z11.01 - NDE Sensors.