NASA SBIR 2008 Phase I Solicitation

X4.04 Composite Structures - NDE/Structures Health Monitoring

Lead Center: JSC

Participating Center(s): ARC, JSC, LaRC

Monitoring systems for advanced composite structures on the Exploration Program vehicles and systems lack sensors that are practically deployable. Monitoring is needed for improved robustness and reliability of composite structures or the mass advantage and performance of composites may not be realized. Adding sensors efficiently at any point in the vehicle lifetime is a necessity since some monitoring is needed for troubleshooting, validation of the loads, strain and thermal environment.

Sensors and their acquisition systems are needed that require a reduced wire infrastructure. Acoustic Emissions (AE) sensors have been shown to receive indications well out ahead of failure. Since propagation distance varies with each configuration and expected fault, many sensors will be needed to ensure composite health. The amount of wiring needed with standard approaches can offset much of the weight savings from composites and increase costs.

New AE sensor mounting methods and flexible sensors are needed that accommodate sometimes highly curved surfaces, don't fail or unbond at cryogenic tank temperatures and withstand high G loading. Very small sensors will need to be embedded at times to accommodate cases where attaching is impractical or the phenomenon can best be measured from within the composite structure.

Wireless sensors and wireless data acquisition systems with local processing of the composite structures events are needed to reduce the wiring and total data handling needs. Totally passive wireless sensor-tags can have advantages in certain applications.

Applications include: Advanced composite structures such as cryotanks, large area composites such as launch vehicle fairings, hard to access/inspect composite members, as well as metallic pressurized structures of all kinds. Interior as well as exterior measurements of the pressure vessel are needed.

Technologies: Flexible, highly efficient piezo materials for sensors, passive sensor-tags for communication, compact sensor data systems for modularity. Versions may be adaptable for acceleration, displacement/strain monitoring CEV parachutes as well for inflatable habitats.

TRL-3 should be achievable by the end of Phase 1.

TRL-6 should be achievable by the end of Phase 2.