SBIR/STTR

Small Business Innovation Research / Small Business Technology Transfer

NASA STTR 2017 Phase I Solicitation

T13.01 Intelligent Sensor Systems

Lead Center: SSC

Participating Center(s): KSC, MSFC

Technology Area: TA13 Ground and Launch Systems Processing

Rocket propulsion development is enabled by rigorous ground testing in order to mitigate the propulsion system risks that are inherent in spaceflight. Test articles and facilities are highly instrumented to enable a comprehensive analysis of propulsion system performance. This topic area seeks to develop advanced instrumentation technologies which can be embedded in systems and subsystems. The goal is to provide a highly flexible instrumentation solution capable of monitoring remote or inaccessible measurement locations. All this while eliminating cabling and auxiliary power. It is focused on near-term products that augment and enhance proven, state-of-the-art propulsion test facilities. Rocket propulsion test facilities within NASA provide excellent test beds for testing and using the innovative technologies discussed above. The technologies developed would be capable of addressing multiple mission requirements for remote monitoring such as vehicle health monitoring.

Embedded sensor systems have the potential for substantial reduction in time and cost of propulsion systems development, with substantially reduced operational costs and evolutionary improvements in ground, launch and flight system operational robustness. Sensor systems should provide an advanced diagnostics capability to monitor test facility parameters including simultaneous heat flux, temperature, pressure, strain and near-field acoustics. Applications encompass remote monitoring of vacuum lines, gas leaks and fire; where the use of wireless/self-powered sensors to eliminate power and data wires would be beneficial.

Sensor technologies should be capable of being embedded in structures and systems that are smaller, more energy efficient allowing for more complete and accurate health assessments including structural health monitoring for long-duration missions. Structural health monitoring is one of the Top 83 Technical Challenges (12.3.5). Nanotechnology enhanced sensors are desired where applicable to provide a reduction in scale, increase in performance, and reduction of power requirements. Specific technology needs include the following:

- Sensor systems should have the ability to provide the following functionality:
    - Measurement.
    - Measure of the quality of the measurement.
    - Measure of the “health” of the sensor.
- Sensor systems should enable the ability to detect anomalies, determine causes and effects, predict future anomalies, and provides an integrated awareness of the health of the system to users (operators, customers, management, etc.).
- Sensors are needed with capability to function reliably in extreme environments, including rapidly changing ranges of environmental conditions, such as those experienced in space. These ranges may be from extremely cold temperatures, such as cryogenic temperatures, to extremely high temperatures, such as those experienced near a rocket engine plume. Collected data must be time stamped to facilitate analysis

with other collected data sets.

- Sensor systems should be self-contained to collect information and relay measurements through various means by a sensor-web approach to provide a self-healing, auto-configuring method of collecting data from multiple sensors, and relaying for integration with other acquired data sets.
- The proposed innovative systems must lead to improved safety and reduced test, and space flight costs by allowing real-time analysis of data, information, and knowledge through efficient interfaces to enable integrated awareness of the system condition by users.
- The system provided must interface with existing data acquisition systems and the software used by such systems.
- The system must provide NIST traceable measurements.
- The system design should consider an ultimate use of Space Flight sensor systems, which could be used for multi-vehicle use.