Project Introduction

Sensatek Propulsion Technology, Inc. proposes to demonstrate the feasibility of a wireless, passive, nanoparticle-based sensor system. The sensor in its current form can be used to measure real time temperatures and pressures wirelessly without the need of an external energy source. It should be noted that the same sensing principle can be used for strain monitoring as well. It comprises of a microwave-resonator-based sensor, a microwave transceiver, and a custom-made antenna. The microwave-resonator-based sensors uses a dielectric resonator structure, a low-profile reflective patch temperature sensor, and a pressure sensor based on evanescent-mode resonator structure. These sensors are made of high-temperature-stable and corrosion-resistant ceramic materials which are suitable for extreme-environment applications. The use of nanoparticles can further reduce the size of the sensor enabling deployment in current hard-to-access areas.

This approach will enable not only surface measurements of pressure and temperature but also provide in-flow measurements of gas path flows at cryogenic and high temperature environments. In-flow measurements within the metal piping of the fluid systems helps provide a dynamic and real time analysis of the operations of the system. Besides, the embedded sensor helps in keeping the structural integrity of the component intact since it’s installation doesn’t require machining pathways as is needed for traditional sensor cables.

The proposed innovation will specifically provide the following benefits for propulsion system test, development & flight applications:

- Reduced cabling costs/time
- Reduced auxiliary power requirements
- Reduced weight penalties/operational costs associated with cabling and auxiliary power components
- Remote, real-time monitoring of component health
- Flexible application due to low profile of sensor
- Extreme environment measurement & survivability

Anticipated Benefits

- Reduced cost and labor requirements associated with instrumentation installation at 8-Foot High-Temperature Tunnel Facility for National Aerospace Plan Concept Demonstration Engine, X43 Hyper-X engine
- Reduce operational costs for various engine test-beds, developmental & launch facilities at SSC, GRC, MSFC and KSC Propulsion Systems Laboratory
- Structural health monitoring into the numerous NASA programs particularly the RS-25 engines on SLS.
Monitoring of harsh environments in inaccessible locations provides insight to increase the reliability and efficiency in systems that includes: HyFly Dual Combustor Ramjet Engine, X43C program’s Ground Demonstrator, Air Force Research Laboratory’s SJX61–1 and SJX61–2 engines; Power Generation & Aviation Gas Turbine Engines for Maintenance & Operational Monitoring; Automotive for Continuous Monitoring for Component Health Indication; and Chemical Plants for Process Control, Safety & Automation.

Primary U.S. Work Locations and Key Partners

<table>
<thead>
<tr>
<th>Organizations Performing Work</th>
<th>Role</th>
<th>Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>★ Stennis Space Center (SSC)</td>
<td>Lead Organization</td>
<td>NASA Center</td>
<td>Stennis Space Center, MS</td>
</tr>
<tr>
<td>Florida State University</td>
<td>Supporting Organization</td>
<td>Academic</td>
<td>Tallahassee, FL</td>
</tr>
<tr>
<td>Sensatek Propulsion Technology, Inc</td>
<td>Supporting Organization</td>
<td>Industry</td>
<td>Tallahassee, FL</td>
</tr>
</tbody>
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Organizational Responsibility

- **Responsible Mission Directorate:** Space Technology Mission Directorate (STMD)
- **Lead Center / Facility:** Stennis Space Center (SSC)
- **Responsible Program:** SBIR/STTR

Project Management

- **Program Director:** Jennifer L Gustetic
- **Program Manager:** Carlos Torrez
- **Principal Investigator:** Reamonn Soto

Technology Maturity (TRL)

- **Start:** 2
- **Current:** 2
- **Estimated End:** 3

For more information and an accessible alternative, please visit: https://techport.nasa.gov/view/94798
Wireless Passive Nanoparticle based Intelligent Sensor System for Extreme Environments, Phase I
Completed Technology Project (2018 - 2019)

Images

Project Image
(https://techport.nasa.gov/image/35057)

Technology Areas
Primary:
- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments/Sensor
    - TX08.3.4 Environment Sensors

For more information and an accessible alternative, please visit:
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