

Topic: N162-105

Innoveering, LLC

Real Time Gas Turbine Engine Particulate Ingestion Sensor for Particle Size and Composition

The Innoveering Particulate Sensor detects air-born particulates that aircraft engines ingest in flight or during landing. The sensor determines size, quantity and speciation of particles. The sensor survives high temperatures inside the engine or is mounted on exterior aircraft surfaces. The sensor uses high temperature plasma as a sensing element and has been developed thru TRL 5 by Innoveering LLC, a technology company focused on high speed and harsh environment applications associated with hypersonic flight. The Particulate Sensor has been adapted for conventional turbine engines powering aircraft such as the V-22. The Particulate Sensor can alert pilots or maintenance crews to harmful engine operating conditions. Prototypes have been tested in laboratory turbine engines in preparation for customers with significant maintenance costs due to contaminant ingestion.

Technology Category Alignment:

Sensors

Air Platforms

Weapons Technologies

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SYSCOM: NAVAIR

Contract: N68335-18-C-0153

 Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-18-C-0153

Department of the Navy SBIR/STTR Transition Program

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WHO

SYSCOM: NAVAIR

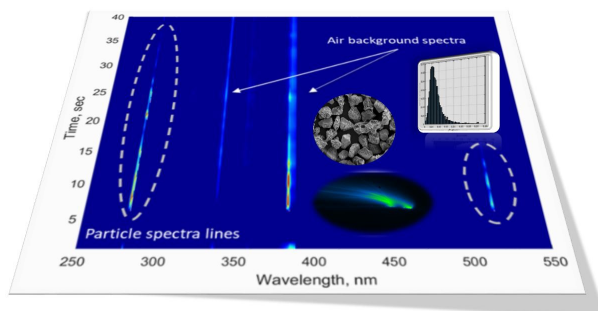
Sponsoring Program: V-22 Osprey, PMA 275

Transition Target: T406 Engine made by Rolls Royce

TPOC:
(301)757-2478

Other transition opportunities: Other aircraft and engines both military and commercial. While the sensor technology is capable of withstanding the severe temperatures and harsh environment inside of the hot section of a turbine engine, sensors also could be placed on other strategic locations of an aircraft. Flight qualification could be simplified for fuselage mounted sensors especially for retrofit applications to existing aircraft. So Program offices that need to improve safety or reduce maintenance costs can more rapidly adopt Innoveering's new particulate sensor if they type qualify the sensor technology in a lower risk mounting location. Program offices could easily bundle the particle sensor with other electronic modules or even weapons systems that they are planning to qualify for flight. Qualification and correlation will be required to establish particle species, and qty of particles encountered in a distal location as compared to that which the engine ingests. However, based on flight conditions this mapping and correlation should be routine and necessary for each new application and aircraft that adopts this technology.

Notes: Innoveering is seeking partners for this application's development engineering stage. Access to maintenance intervals and potential cost savings would benefit the platform ROI calculations and allow the Navy to better field the particulate sensor into the highest priority applications beyond the V22 Osprey.



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WHAT

Operational Need and Improvement: Turbine engines especially on rotor aircraft ingest high levels of dust, sand and ash that harm compressor blades and other critical engine components. This can occur in flight and during landings and takeoffs. The amount or particles and constituent makeup of particles is desired to be understood in real-time so that the pilot can make informed decisions based on these exposures. Also maintenance intervals can be tailored to engine exposure instead of a standard interval that may have little relevance to actual need for maintenance.

Specifications Required: Turbine engine performance and qualification standards.

Technology Developed: A sensor that can detect air born particulates that aircraft are exposed to in flight or during landing. The sensor can determine size, quantity and speciation of select constituent elements of the particles. The sensor can survive high temperatures so it can be mounted in the engine or on exterior aircraft surfaces. The sensor uses a combined electro-optical measurement approach to detect, process and measure particle properties.

Warfighter Value: Pilots immediately know if they have are in a dangerous situation due to engine particle ingestion. It can prevent fatal crashes due to this engine failure condition. Also maintenance of aircraft becomes better to target potential failures before they occur and to reduce costs for unnecessary maintenance if particles have not been ingested at a high rate.

- ✓ Compact, rugged, in-situ sensor system that can be integrated at several places within an engine.
- ✓ System integrates with multiple engines/aircraft with minor modification.
- ✓ System interfaces with an engine and/or aircraft health monitoring computer.
- ✓ Probe does not adversely affect airflow into or inside the engine.
- ✓ Sensitivity and selectivity of measurement to all of the materials of interest.
- ✓ Accurate size and concentration measurement using a localized multi-sensor approach.

WHEN

Contract Number: N68335-18-C-0153 **Ending on:** December 1, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Systems/Subsystems Specifications	N/A	Submission and Review	3	July 2018
Brassboard System Assembly and Demonstration	Low	Species and size measurement in a laboratory environment	4	July 2019
Brassboard System Testing in an Engine Environment	High	Particle size and species concentration measured in an operating gas turbine engine environment	5	October 2020
Prototype System Integrated Testing	Med	Demonstration of integrated operation to detect, process and output engineering values on particle properties.	5	October 2021
Prototype System Operational Testing in Full Scale Engine	High	Real-time engineering value output of particle size, species, and concentration.	6	September 2022

HOW

Projected Business Model: Innoveering will scale and manufacture sensors in house and distribute our line of sensors with other sensors through standard aerospace distribution channels. We have personnel experienced in product realization for manufacturing and product commercial ization to grow business opportunities.

Software and sensor hardware will be produced and sold by Innoveering that can lead to potential DoD program savings if final sensor and hardware requirements and packaging are similar to other applications. Start-up costs, such as tooling and minimum production run needs, can possibly be shared by multiple programs. This not only shares costs, but also reduces program risks for design validation, as well as, ongoing production quality considerations. By identifying additional programs we will improve the likelihood of multiple revenue generation channels. Parallel revenue streams can be realized through sales to combustion and aero-propulsion ground test facilities as well as to ground based turbine cycle power generation facilities and other high temperature processing industries.

Company Objectives: We are seeking DoD, DoS and other government end users of turbine aircraft to endorse and request use of our sensors through their supplybase. We are in contact with engine customers and commercial airlines for commercialization opportunities.

Potential Commercial Applications: Commercial aircraft applications either in engine or fuselage mounted.

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