Topic: N152-095

Innoveering, LLC

Micro-Plasma Blade Monitoring Sensor System

Innoveering is developing a sensor system that is capable of operating uncooled in the ultra-high temperature environments (>2500 oF) of gas turbine engines to provide real-time turbine blade health monitoring information. A micro-distributed transduction approach in combination with novel processing enables real-time tracking of blade tip dynamics with high spatial and temporal resolution. Fabricated miniature probes leverage high temperature materials and exceed current size requirements. A frequency response in excess of 1MHz has been demonstrated in subscale gas turbine tests. The targeted application is the Joint Strike Fighter Program and improved understanding of integration requirements will assure a successful transition, and support Innoveering's mission of developing revolutionary technologies that address sensing and control challenges in the aerospace, defense and energy markets.

Technology Category Alignment:

None
None
None

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SYSCOM: NAVAIR
Contract: N68335-17-C-0249

Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-17-C-0249

Department of the Navy SBIR/STTR Transition Program

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NAVAIR JSF17-821

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WHO

SYSCOM: NAVAIR

Sponsoring Program: Joint Strike Fighter Program Executive Office (JSF/PEO)

Transition Target: F135 Engine

TPOC:
(301)757-0490

Other transition opportunities: The Variable Cycle Advanced Technology (VCAT) Program, a partnership effort between ONR and the Department of the Navy's Task Force Energy (TFE) is exploiting recent advancements in variable/adaptive cycle turbine engine technology. The Army ABRAMS M1 Tank for surge protection and compressor stall monitoring.

WHAT

Operational Need and Improvement: The ability to monitor the structural health of the rotating components is of major interest to the aero community in improving engine safety and reliability. This is true for the Department of Defense where current developmental and future engines will need to operate at high efficiencies to meet the mission-weighted fuel burn requirements. This means engines operate with tighter running clearances, increased blade loading, at substantially higher temperatures.

Specifications Required: Current blade health monitoring sensors are capable of operating at 1100°F continuously uncooled, and have been demonstrated to work up to 1800°F with cooling. However, the use of active cooling brings forth undesired effects, and hence, a need exists to develop uncooled sensors that can operate in a +2500°F, 450 psia environment in the aft end of the turbo machinery. As gas turbine engine designs progress, the high-temperature need will also arise for sensors in the compression system.

Technology Developed: A new sensor system that leverages glow discharge electric field variances to detect local fluid flow changes that are due to pressure and flow shear. The sensor is a solid state design featuring simple and low cost construction. The approach provides an innovative, compact, rugged, in-situ engine sensor solution that can yield the appropriate data to be used for identifying (and reporting) blade high cycle fatigue (HCF) and foreign or domestic object damage (FOD or DOD) events in real time through the use of spatial and time-domain signal analysis.

Warfighter Value: Sensor system interest is driven by higher engine performance requirements resulting in higher turbine temperatures and compression ratios. MIL-HDBK-1783, A4.13.3 provides requirement guidance that any component within or mounted to the engine should have a probability of failure due to high cycle fatigue (HCF) below 1 X 10-7 per EFH on a per stage basis, provided the system level safety requirements are met. Real time health monitoring provides early warning when an engine turbine blade inspection is needed before a catastrophic failure can occur

WHEN

Contract Number: N68335-17-C-0249 **Ending on:** March 15, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Assemble brassboard sensor system	Med	Demonstrate measurements under relevant kinematic conditions in full scale turbine rig.	4	October 2017
Demonstrate operation under combined elevated pressure and temperarture conditions	Med	Operate for 45 minutes under 450 psia and 1500 F conditions	4	February 2018
Assemble prototype system and demonstrate within a true scale gas turbine environment	High	Operate for 60 minutes under 450 psia and 2000 F conditions	5	February 2019
Perform testing under ultra high temperature conditions	High	Operate for 90 minutes under 450 psia and 2500 F conditions	5	February 2020

HOW

Projected Business Model: Innoveering business model for the turbine blade health monitoring system is to form an alliance with an engine OEM whereby a joint venture is pursued to commercialize the technology, for military and non-military applications. Innoveering will license the technology to the new company and provide technical assistance in further developing and transitioning it to the product phase.

Company Objectives: Innoveering is focused on providing innovative sensing and control solutions for high pressure and high temperature applications, within the aerospace, defense, power and energy markets. We specialize in formulating practical solutions that can transition on-board vehicle platforms and interested in expanding our role as a go-to organization through custom solutions and niche product offerings.

Potential Commercial Applications: It is expected that real time health monitoring will play an increasingly important role towards maintaining reliability and avoiding failures for land based gas turbines in the power generation market.

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