Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2018-659

Topic # N162-100

Integrated Hybrid Structural Health Monitoring (SHM) System

Redondo Optics, Inc.

WHO

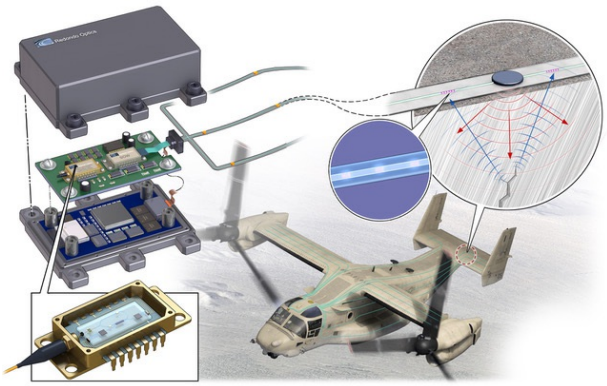
SYSCOM: NAVAIR

Sponsoring Program: PMA-275

Transition Target: V-22 Osprey

TPOC:
(301)757-2031

Other transition opportunities: System may be integrated into any Navy/Marines, Army, and Air Force rotorcraft platform that is equipped with SHM sensor and power systems. Specific programs include CH-53 Helicopter Program (PMA-261), H-60 Multi Mission Helicopter Program Office (PMA-299), V-22 Program Office (PMA-275), Tomahawk Weapon Systems (PMA-280), and the In-Service Aircraft Carrier Program Office (PMS-312)



Hybrid PZT/FBG Fiber Optic Acoustic-Ultrasound SHM System
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Notes: Redondo Optics, Inc. (ROI) business model is to transition SBIR technologies from the onset of the Phase I program to the commercial sector and to progressively increase the TRL level for transition to prime contractors and Navy operations. ROI has initiated sales of hybrid FAULSense SHM systems to key customers in need of dynamic SHM damage detection and localization systems within diverse markets from aerospace, aviation, energy plants, automotive, transportation, and rotorcraft.

WHAT

Operational Need and Improvement: Effective rotorcraft SHM systems must possess the ability to detect and track the rotorcraft structural response and the onset and progression of structural damage as well as monitor the actual environment and loading conditions the structure experiences. Current SHM systems utilize piezoelectric (PZT) actuators and fiber optic (FO) sensors separately. Issues with current SHM systems utilizing PZTs include difficulties with cross communication between sensors and signal attenuation during long distance transmission. A hybrid diagnostic system that can capture damage and loads data by using PZT actuators to input controlled structural excitation and FO sensors to measure the corresponding structural response without the usually associated weight and cable wiring complexity penalties would have enormous benefits.

Specifications Required: Fully integrated, low-weight, hybrid Structural Health Monitoring (SHM) system that effectively utilizes FO sensors and PZT actuators to capture damage data and corresponding structural response. The FO and PZT sensors should be configured for placement onto the structure without structural degradation. The hybrid system will be evaluated on its damage detection, damage quantification, and static/dynamic loads monitoring capabilities. The hardware and software for data acquisition and processing should be packaged as a single unit and must be as small and lightweight as possible. Integration with the current V-22 Vibration/Structural Life and Engine Diagnostics (VSLED) system is desired.

Technology Developed: A no-moving-parts, ultra-low power, light weight, and miniature size, distributed hybrid “piezo-electric/fiber-optic” acousto-ultrasound sensor (FAULSense) network SHM system suitable for the in-situ, un-attended detection, identification, localization, and tracking of structural damage as well as to monitor the actual static and dynamic structural load environment in Navy rotorcraft and other aircraft.

Warfighter Value: Usage information taken from the FAULSense SHM system would expand the capability of Vibration/Structural Life and Engine Diagnostics (VSLED) rotorcraft systems, allowing maintainers to be alerted when key structural components are about to show signs of degradation, resulting in increased safety and reduction in unnecessary maintenance. Additionally, faster maintenance turnaround would translate into improved aircraft availability and lower life cycle costs.

WHEN

Contract Number: N68335-18-C-0242 **Ending on:** February 26, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Produce FAULSense SHM Engineering System	High	Demonstrate FAULSense system capable of the detection, identification, and locatization of hidden damage in relevan rotorcraft structure	4	September 2019
Field Test Qualify FAULSense SHM Engineering System	Med	Demonstrate FAULSense SHM system Operation in Static Rotorcraft Environment	5	February 2020
Develop Airworth Qualification Plan	Med	Test Plan Approved by Prime Contractor	5	May 2020
MILSPEC Qualify FAULSense SHM System	High	Demonstrate MILSPEC Performance	6	December 2020
FAULSense SHM System Rotorcraft Fly Test	High	Demonstrate Fly Test Performance	7	February 2021

HOW

Projected Business Model: The integrated engineering design of the FAULSense SHM system is made for low cost, pick-and-place, large-scale production using well established manufacturing practices used in the communications industry. Redondo Optics automated manufacturing facilities currently have the capability of pilot production at levels of 100 FAULSense units per month. If larger production quantities are required, ROI has established outsource manufacturing lines with production foundries used by the semiconductor and telecommunication industry to achieve production levels of 10,000 units per year. For Mil-Spec qualification of the FAULSense SHM products, ROI will outsource testing and qualification to independent test qualification laboratories. Flight qualification of the FAULSense system will be conducted with the support of the Navy and the prime contractor manufacturer. The final Mil-Spec and flight qualified FAULSense SHM system will be delivered to a strategic prime contractor for integration to the target helicopter platform.

Company Objectives: This condition based maintenance functionality is in line with current Navy programs like the V-22 Osprey Vibration/Structural Life and Engine Diagnostics (VSLED) program, which is an effort aimed at developing rotorcraft airframe and rotor system Structural Health Management (SHM) capabilities. ROI plans to continue its rapid expansion into fiber optic and wireless sensor markets for avionics and aerospace applications, and progressively and strategically working with prime contractors, i.e., Boeing, BAE, Northrop-Grumman, Lockheed-Martin, Sikorsky, Airbus, etc., for integration of FAULSense SHM systems in rotorcraft and UAV platforms.

Potential Commercial Applications: ROI’s FAULSense SHM system will provide a cost affordable wireless sensor solution for many of the Navy’s structural health monitoring applications. Specific Navy applications include SHM monitoring in rotorcraft, all types of aircraft, and naval ship and submarine systems. In the commercial sector FAULSense has applications in renewable energy (wind mills, solar plants, nuclear plants), civil infrastructures, oil and gas, energy exploration, medical, and security.

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