

Department of the Navy SBIR/STTR Transition Program

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Topic # N131-011
High-Speed Self-Power Wireless Fiber Optic Sensor (WiFOS) Structural Health Monitoring System for Helicopter Rotors
Redondo Optics, Inc.

WHO

SYSCOM: NAVAIR

Sponsoring Program: Heavy Lift Helicopter Program office (PMA-261)

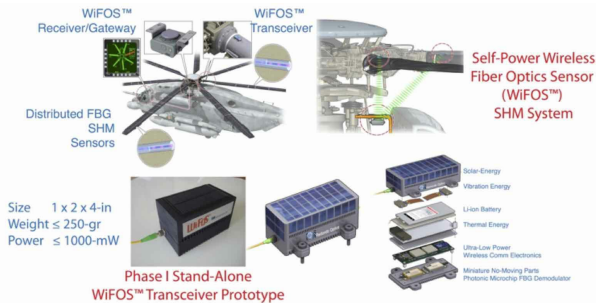
Transition Target: CH-53K King Stallion

TPOC: (301)342-8396

Other transition opportunities:

Multi Mission Helicopter Program Office (PMA-299) on the H-60 Helicopter Program, V-22 Joint Program Office (PMA-275) on the V-22 Program, Tomahawk Weapon Systems (PMA-280) , and the In-Service Aircraft Carrier Program Office (PMS-312)

Notes: The image above is a representation of Redondo Optics' light weight, self-power, Wireless Fiber Optic Sensor (WiFOS™) System



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WHAT

Operational Need and Improvement: The Navy has a need to implement health and usage monitoring systems (HUMS) in the helicopter fleet for increased reliability and safety as well as reducing maintenance and operational costs and maximizing operational readiness. Current HUMS require direct wire connection to the sensor element for data acquisition. Redondo Optics' (ROI) WiFOS™ system eliminates costly and potentially trouble prone wire harness installations, allowing measurements in critical inaccessible locations within the rotating parts of the helicopter without the need of complex slip-ring connections.

Specifications Required: The structural health monitoring (SHM) system must be capable of transferring health and usage sensor data from the rotor blades to a base station unit in the non-rotating frame via wireless transmission. The sample data rates shall be programmable depending on the data source, ranging from 10-5000 Hz, for customizable use. Sampling rates should be a minimum of five times the maximum input signal frequency of interest. The system must optimize use of materials and electronics to achieve a low weight, not to exceed 2 pounds.

Technology Developed: ROI developed an ultra-low power (≤ 700-mW), light weight (≤750-gr), and small size (2-in x 2-in x 4-in) energy harvesting wireless stand-alone bench top prototype capable of monitoring the structural health (strain, vibration, and temperature) of a simulated graphite composite blade test article exposed to a helicopter like environments, and collecting the sample data at rates of ≥6-kHz, with on-board data reduction to wirelessly transmit the sensor SHM data to a remote test station. This will be hardened, demonstrated and flight tested in phase II.

Warfighter Value: ROI's compact and rugged, next generation WiFOS™ system is designed for operation and compliance in extreme Navy helicopter environments that commonly experience large strain, temperature, and vibration conditions. The WiFOS™ unique capability of real time load and fatigue damage detection, tracking, and prognosis for the helicopter rotor structural components will improve flight mission reliability and provide enhance condition-based maintenance while substantially reducing operational costs.

WHEN

Contract Number: N68335-14-C-0375 Ending on: June 10, 2016

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Produce WiFOS Engineering System	High	Demonstrate Low Power WiFOS system	4	December 2015
Test Qualify WiFOS Engineering System	Med	Demonstrate WiFOS System SHM Performance	5	June 2016
Develop Airworthiness Qualification Plan	Med	Test Plan Approved by Prime Contractor	5	September 2016
MIL SPEC Qualify WiFOS System	High	Demonstrate MIL-SPEC Qualification	6	February 2017
Fly Test WiFOS System	High	Demonstrate Fly Test Performance	7	June 2017

HOW

Projected Business Model: The integrated engineering design of the WiFOS™ 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 WiFOS™ 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 WiFOS™ SHM products, ROI will outsource testing and qualification to independent test qualification laboratories. Flight qualification of the WiFOS system will be conducted with the support of the Navy and the prime contractor manufacturer. The final Mil-Spec and flight qualified WiFOS™ SHM system will be delivered to a strategic prime contractor for integration to the target helicopter platform.

Company Objectives: Redondo Optics Inc. plans to continue its rapid expansion into optical instrumentation and sensor markets. The WiFOS™ family of products resulting from this project will contribute substantially to expand the line of fiber optic sensor instrumentation for avionics and aerospace applications. ROI is looking for more Navy programs of interest and prime contractors for integration of the WiFOS™ SHM system.

Potential Commercial Applications: ROI's self-power wireless WiFOS™ system will provide a completely new, innovative, and cost affordable wireless sensor solution for a large number of the Navy's structural health monitoring applications for use in avionics, maritime, and terrestrial operations. Specific Navy applications include SHM monitoring in rotorcraft, all types of aircraft, and naval ship and submarine systems. In the commercial sector WiFOS™ has applications in renewable energy (wind mills, solar plants), civil infrastructures, oil and gas, energy exploration, medical, and security.

Contact: Edgar Mendoza, CEO/President
emendoza@redondooptics.com 310-292-7673