

Topic: N151-006

## Redondo Optics, Inc.

Low Power, Low Cost, Lightweight, Multichannel Optical Fiber Interrogation Unit for Structural Health Management of Rotor Blades

The CH-53K Integrated Hybrid Structural Management System (IHSMS) increases reliability and safety, reduces maintenance and operational costs, and maximizes operational readiness of the Navy's helicopter fleet. Current IHSMS requires direct electrical wire connection of the SHM sensors within the rotor and blades exceeding weight and power requirements. Consequently, Redondo Optics is developing a high-speed, self-powered, wireless fiber optic sensor (MOFIS™) SHM system to provide real-time load and fatigue damage detection, tracking, and prognosis for the helicopter rotor structural components. The MOFIS™ system operates in extreme Navy helicopter environments, eliminating costly, potentially trouble prone wire harness installations, allowing measurements in critical inaccessible locations within the rotating parts of the helicopter without complex slip-ring connections. Potential to integrate into all structural health usage management/monitoring systems (HUMS).

### Technology Category Alignment:

Rotary Wing Vehicles

Test, Evaluation, Validation, and Verification

Maintainability/Sustainability

Corrosion

Acoustic, Seismic and Magnetic

### Contact:

Edgar Mendoza, Ph. D

[emendoza@redondooptics.com](mailto:emendoza@redondooptics.com)

(310) 406-1295

<http://www.redondooptics.com>

**SYSCOM:** NAVAIR

**Contract:** N68335-16-C-0340

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-16-C-0340](https://navystp.com/vtm/open_file?type=brochure&id=N68335-16-C-0340)

# Department of the Navy SBIR/STTR Transition Program

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

NAVAIR 2017-735

Topic # N151-006

Low Power, Low Cost, Lightweight, Multichannel Optical Fiber Interrogation Unit for Structural Health Management of Rotor Blades

Redondo Optics, Inc.

## WHO

**SYSCOM:** NAVAIR

**Sponsoring Program:** PMA 261

**Transition Target:** PMA 261, CH-53K Heavy Lift Helicopter

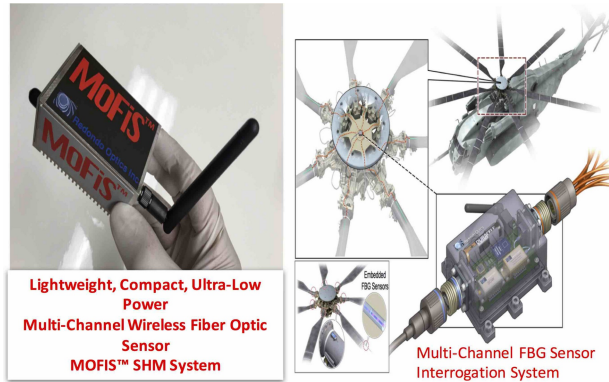
**TPOC:**

(301)342-3632

### Other transition opportunities:

System may be integrated into any Navy/Marines, Army, and Air Force rotorcraft platform that is equipped with wireless Structural Health Management (SHM) sensor and power systems. Specific programs include 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:** Redondo Optics, Inc. (ROI) business model is to transition SBIR technologies from the onset of the Phase I program to the commercial sector. ROI has initiated sales of MOFIS systems to key customers in need of miniature, lightweight, battery power, and wireless communication within diverse markets from energy plants, automotive, transportation, and rotorcraft.



Copyright, 2017, Redondo Optics, Inc.

## WHAT

**Operational Need and Improvement:** The main rotor blades and associated rotating hardware are some of the highest dynamically loaded parts found on rotorcraft. These dynamic parts have historically been hard to instrument without a significant weight penalty and are often inspected at intervals. A system capable of monitoring true strains, as well as damaging impacts during rotorcraft operation, without the usually associated weight penalties would have enormous benefits.

**Specifications Required:** The system must be of low volume (less than 200 cm<sup>3</sup>) and weight (no greater than 0.33 kg), and be capable of interrogating an optical fiber containing 15 sensing locations in a single blade, and have no moving parts. The sensor interrogator should also be able to withstand the high vibrations and loads found in a Naval rotor system in which it will be installed. The interrogator must be able to accurately resolve the large blade strains produced by a helicopter blade, and be able to obtain data from each sensor at a rate of at least 1 KHz. The interrogator must also be able to operate efficiently, drawing no more than 3 watts of power.

**Technology Developed:** A no-moving-parts, ultra-low power, light weight, and miniature size, multi-channel optical fiber interrogation (MOFIS) structural health monitor system suitable for the in-situ non-intrusive integration to a helicopter composite blade to enable the in-flight distributed multi-point measurement of true-strain, temperature, vibration, and impacts associated with excessive loads, fatigue, and structural damage within the composite blades structure.

**Warfighter Value:** Usage information taken from this system would enable health and usage monitoring (HUM) of the rotor system, allowing maintainers to be alerted when 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:** N68335-16-C-0340 **Ending on:** September 17, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Produce MOFIS Engineering System	High	Demonstrate Low Power MOFIS SHM System	4	September 2017
Test Qualify MOFIS Engineering System	Med	Demonstrate MOFIS SHM system Operation in Rotor Environment	5	May 2018
Develop Airworth Qualification Plan	Med	Test Plan Approved by Prime Contractor	5	September 2018
MILSPEC Qualify MOFIS System	High	Demonstrate MILSPEC Performance	6	March 2019
MOFIS System Rotorcraft Fly Test	High	Demonstrate Fly Test Performance	7	September 2019

## HOW

**Projected Business Model:** Projected Business Model: The integrated engineering design of the MOFIS 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 MOFIS 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 MOFIS SHM products, ROI will outsource testing and qualification to independent test qualification laboratories. Flight qualification of the MOFIS system will be conducted with the support of the Navy and the prime contractor manufacturer. The final Mil-Spec and flight qualified MOFIS 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 CH-53K Integrated Hybrid Structural Management Systems (IHSMS), 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., Lockheed-Martin, Boeing, BAE, Northrop-Grumman, Airbus, etc., for integration of MOFIS SHM systems in rotorcraft and UAV platforms.

**Potential Commercial Applications:** ROI's MOFIS system will provide a cost affordable wireless sensor solution for many 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 MOFIS has applications in renewable energy (wind mills, solar plants, nuclear plants), civil infrastructures, oil and gas, energy exploration, medical, and security.

**Contact:** Edgar Mendoza, Ph. D, Chief Executive Officer  
[emendoza@redondooptics.com](mailto:emendoza@redondooptics.com) (310) 406-1295