Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-725

Topic # N162-097

Non-Contact Torque Sensor for Unmodified Composite Shafts and Non-Ferrous Metal Shafts

Prime Photonics, LC

WHO

SYSCOM: NAVAIR

Sponsoring Program: PMA-265

Transition Target: F/A-18 Hornet/Super Hornet

TPOC:
(301)757-2504

Other transition opportunities: Commercial rotorcraft and shipboard would benefit from a reliable non-contact torque measurement solution. There are also numerous applications where non-contact torque measurement would be beneficial, to include industrial, power generation, mining, agricultural and automotive industries. The market includes both troubleshooting/diagnostic of drivetrain issues and long-term monitoring for early detection of drivetrain problems.

US Navy photo, https://www.navy.mil/view_image.asp?id=173195

WHAT

Operational Need and Improvement: A torque sensing solution for both nonferrous metals and carbon-fiber reinforced composite shafts that does not install onto, or modify the drive shaft is needed.

Specifications Required: The goal is to deliver a non-invasive torque sensing capability that has the least possible impact on existing and next generation equipment designs, while also enabling practical upgrades to existing platforms to meet expanding mission requirements. The sensor will measure torque up to a minimum of 2kHz with recorded data rates exceeding a minimum of 5kHz.

Technology Developed: Torque and Torsional Vibration Sensor (TVS) is an all-optical sensor that measures torque and torsional vibration on rotating equipment drive trains, including shafts and couplings. TVS can be used to validate new equipment designs during development, diagnose in-service performance and vibration problems, or continuously monitor equipment health. Torsional vibration or torque spikes are difficult to detect because, prior to the TVS sensor, they required modifications to the shaft (such as an in-line torque cell or mounting of strain gauges) to diagnose or quantify. The sensor allows early detection of potential failures due to high-cycle fatigue or low-cycle over torque events.

Warfighter Value: TVS will reduce cost of ownership, improve uptime, and improve safety when operating high speed drive trains by allowing torque and torsional vibration to be continuously monitored on existing equipment without requiring redesign or requalification of the equipment. Value to the warfighter is threefold: 1) avoiding a single catastrophic shaft failure saves a multi-million dollar asset, whether it be an aircraft or a ship engine; 2) early detection of a drivetrain issue allows replacement of only the incriminated component instead of a multitude of subsystems after failure; and 3) the ability to troubleshoot torque and torsional vibration issues on any drivetrain without disassembly saves between 8 and 16 man-hours per diagnostic.

WHEN

Contract Number: N68335-18-C-0059 **Ending on:** October 1, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Validation on F/A-18 Aircraft Mounted Accessory Drive (AMAD) rig	Med	Meet target specifications	5	October 2020
Simultaneous optical probe vibration and validation on AMAD	Med	Meet target specifications	6	April 2021
Engineering data requirements agreement plan (EDRAP) for F/A-18 flight test	Low	Plan approved by Navy	6	January 2022
Validation flight testing	Low	Meet target specifications	7	July 2022

HOW

Projected Business Model: Manufacture and sell to Navy integrators, and sell direct to commercial markets.

Company Objectives: To identify aircraft and shipboard Navy applications where TVS can provide value for rotating equipment test, diagnostics or health monitoring.

Potential Commercial Applications: Industrial drive train torque measurements, health monitoring, torsional vibration diagnostics and monitoring. Potential markets include monitoring of couplings between a drive (turbine, motor) and driven equipment (compressor, pump) in power generation applications, ship drivetrains, automotive drivetrains, and oil & gas systems.

The sensor can be used as a troubleshooting and diagnostic tool to identify torque spikes and torsional vibration resonances in a vibrating drivetrain. It can also be used for permanent monitoring of an asset and detecting changes in torque over time which is an early indication of a problem in the drivetrain.

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