Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-842

Topic # A02-075

Non-Contacting Torque Sensor for Helicopter Tail Rotor Drive Systems.

International Electronic Machines

WHO

SYSCOM: NAVAIR

Sponsoring Program: H-53 Heavy Lift Helicopters Program Office (PMA-261)

Transition Target: CH-53K IHSMS

TPOC:
(301)342-9428

Other transition opportunities: H-60, CH-47, and other rotorcraft

Notes: IEM's flagship WISE® suite of railroad safety and maintenance inspection products were developed and derive from SBIR work, some dating back to 1997 and others through the 2000s. Our USDOT Transportation Autonomous Device (TAD) unmanned railroad inspection vehicle had its further development funded by a Class One railroad for millions of dollars, and our Vibration Monitoring System (VMS) for Sound Transit derives from SBIR projects in vibration and acoustic sensing, and the current TMS is a continuation of both early SBIR work through 2007 and other testing and development work with two major aircraft manufacturers. Multiple other commercial or non-SBIR government projects had their genesis in other SBIR projects with both military and non-military Federal agencies.

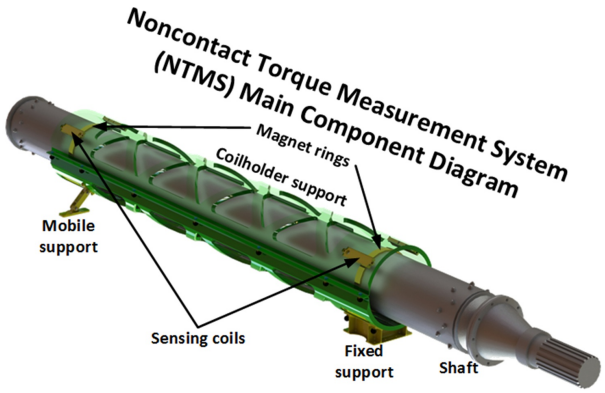

Diagram of the NTMS by IEM Corp., Copyright 2020

WHAT

Operational Need and Improvement: Rotorcraft expend the majority of their power (~70%) to lift the craft into the air. The remaining ~30% determines cargo capacity, maneuvering power, and so on. Current-art systems for measuring torque are generally contact (thus subject to wear) and often cannot achieve accuracies over +/-4%. This limits the safe operation of the rotorcraft, and prevents the use of condition-based maintenance (CBM) on the shaft and related components (as accurate strain/torque measurement is necessary for condition tracking). There is thus a need for an accurate (~1% or better), noncontact, easily-installed method for torque measurement on rotorcraft.

Specifications Required: The desired system will provide accurate (to 1%) torque measurements in real-time with no contact involved, add no more than 10 pounds of weight, and maintain a clearance of at least 1/2" nominal from the shaft in operation; the system should be easily installed and require no permanent changes to the shaft. High-speed sampling (to detect torque transients), lower weight, and higher accuracy are desirable.

Technology Developed: IEM has developed a patented, accurate, low-power, high-speed method to measure torque on an operating rotorcraft driveshaft (or other similar shafts). IEM's Noncontact Torque Measurement System (NTMS) can be retrofitted to existing aircraft without permanent changes to the shaft, achieves an accuracy of 1% full-scale torque measurement, and can achieve liftoff of over 0.75 inches in operation. The system is lightweight (well under 10 pounds) and will provide data of sufficient accuracy and frequency for use in CBM or in direct flight operations. The system neither produces significant EMI nor is easily interfered with by external EMI. It is potentially able to be self-powered and/or wireless as well.

Warfighter Value: The use of the NTMS would provide operators of rotorcraft with the ability to safely make use of a greater proportion of the maneuvering and lift torque of the craft, while also allowing a more reliable and cost-effective way of ensuring the operational safety of the shaft and related components. This translates overall to reduced maintenance time and replacement costs, improved safety, and improved operational performance of the aircraft.

WHEN

Contract Number: N68335-19-C-0237 **Ending on:** April 9, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Prior Test Data Delivered	N/A	Testing data obtained and verified usable	6	May 2019
Shaft motion characterized and coilholder base design determined	N/A	Coilholder design created that meets performance and weight guidelines	6	May 2020
New Testbed Constructed	Low	Testbed design and construction to meet motion parameters	6	November 2020
New Prototype Tests Completed	Low	Complete tests with redesigned prototype	6	January 2021
Complete final design for Flight Test	Med	Based on test results create design that addresses any issues seen	6	April 2021
Flight Testing	Med	Install NTMS on Test Aircraft and fly	7	October 2022

HOW

Projected Business Model: IEM expects to manufacture the TMS in our facilities at a low production rate. If demand is sufficient, IEM may expand our facilities, or license manufacturing to a larger concern. IEM already manufactures our other major products on-site and understands these processes well.

Company Objectives: The NTMS began as a Phase I and II with the U.S. Army through 2007; this became a Phase III with a major rotorcraft manufacturer, who has then supported this Phase II.5 for additional development. IEM wishes to meet with other major rotorcraft or aircraft manufacturers, or any other manufacturers/users of vehicles with instrumentable driveshafts that could make use of this technology. While IEM can manufacture at low volume, licensing or other arrangements are possible.

Potential Commercial Applications: The NTMS technology has broad commercial applications, starting with all commercial rotorcraft; the same basic needs and limitations of military rotorcraft apply to civilian rotorcraft and thus the NTMS offers the same advantages for the operation and maintenance of the aircraft. In a broader sense, the NTMS applies to any vehicle, ground, sea, or air, which has its motive force transferred through a shaft at any point; it also may apply to any power generator or motor with a significant shaft length to be monitored.

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