Department of the Navy SBIR/STTR Transition Program

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Topic # N182-111
Propellant Grain Cracks Detection System
Intellisense Systems, Inc.

WHO

SYSCOM: NAVAIR

Sponsoring Program: PMA-201 Precision Strike Weapons

Transition Target: The MK109 rocket motor

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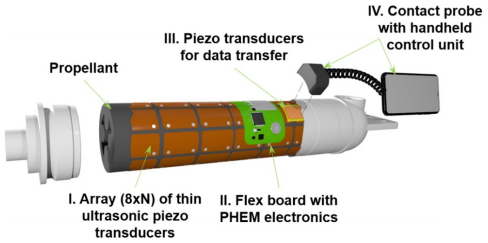
Other Transition Opportunities: Multiple models of rocket motors, gas generators, and propellant actuated devices in current use on military airplanes such as Super Hornet F/A-18.



Notes: The Propellant Health Monitoring (PHEM) system is based on the novel integration of piezoelectric transducers for propellant health inspection with ultralow-power components and electronic design. Specifically, this unique integration of ultrasonic propellant-monitoring sensors enables PHEM to detect cracks; the implemented data transfer link allows the status data to be transferred through the metal walls of the sealed rocket motor case.

WHAT

Operational Need and Improvement: The PHEM system addresses the Navy's need for a sensor capable of detecting cracks in propellant grain and transmitting the sensor data wirelessly through a hermetically sealed rocket motor case.

Specifications Required: - Detection of cracks in propellant
- Transmitting data through the sealed metal case
- System size - thickness < 0.08 in.
- Long service life - 10 years
- Compatibility with harsh conditions
- Store data history for download
- Integration with MK 109 rocket motor design
- Compatibility with the current manufacturing process

Technology Developed: The Propellant Health Monitoring (PHEM) system is an ultrasonic sensor suite capable of detecting cracks in propellant grain and transmitting the relevant data through a hermetically sealed rocket motor case. It is developed by Intellisense Systems, which creates advanced sensing and display solutions.
The distinguishing features of PHEM are: its thin form factor (<2 mm), ability to conform to a cylindrical surface, ultralow power consumption (10 year lifetime), and implementation of a communication link that operates through the metal wall. Intellisense has demonstrated functionality of the sensor, performed initial measurements with live propellant, and developed plans for tests and integration into a rocket motor.

Warfighter Value: PHEM is designed to detect cracks in propellant grains and transmit that data through the hermetically sealed rocket motor case, it provides the critical capability to monitor the health of the propellant-actuated components in military aircraft (such as the MK 109 canopy remover rocket motor for the Super Hornet F/A-18). PHEM can also be used to detect failing solid rocket motors in missiles and other propellantactuated devices (PADs) and cartridge-actuated devices (CADs), and in applications involving missiles, weapons, or the jettison of pylons or fuel tanks in the event of an emergency. PHEM will improve warfighter safety and reduce total ownership costs for energetic devices.

WHEN

Contract Number: N68335-20-C-0230 **Ending on:** Jun 27, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
PHEM feasibility demonstration	N/A	Key PHEM features were demonstrated in Phase I	3	2nd QTR FY19
PHEM prototype is developed in Phase II	N/A	Flexible PHEM PCB was developed and tested	4	4th QTR FY23

HOW

Projected Business Model: Intellisense developed a transition plan that initially includes the following key steps: - Present the PHEM technology at military and industry tradeshows to increase awareness of the technology, solicit feedback regarding interest and expected concepts of operation, and identify relevant primes and key industry stakeholders to establish formal partnerships for transition beyond the Phase II effort. - Perform preliminary and critical design reviews of the technology in a Phase IIE or Phase III development phase. - We plan to develop PHEM to TRL-7/8 and then transition to low-rate initial production, selling directly to primes. - The MK 109 rocket motor will be the first target for PHEM transition; we also plan to partner with primes such as Boeing and Lockheed Martin to integrate PHEM in other rocket motors used in airplanes.

Company Objectives: Intellisense intends to leverage the PHEM technology to develop a family of compact autonomous ultrasonic sensors that will be integrated into various weapon systems to monitor the health of propellant.

Potential Commercial Applications: PHEM's ability to measure cracks in propellant grains and transmit the measurement data through sealed rocket motor case wirelessly enables it to be used in automotive, aviation, and commercial space operations, for detection of defects in gas generators, PADs, and CADs, and to provide critical actionable information. PHEM can be modified to meet the requirements of different platforms with devices like CADs (explosive bolts, pin pullers), PADs (gas generators), and electro explosive devices, such as pressure cartridges, detonators, and linear explosive transfer lines.

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