

Topic: N10A-T042

Metis Design Corporation

Probability of Detection (PoD) Toolbox for Guided Wave based Structural Health Monitoring (SHM)

Metis Design Corporation (MDC) has developed Structural Health Monitoring (SHM) technology that utilizes a network of digital sensors to monitor physical changes in critical structural components within the application environment. The patented technique utilizes passive and active ultrasonic monitoring techniques to detect fatigue crack initiation and growth, corrosion, and/or impact events. Condition Based Maintenance (CBM) initiatives have been evolving for over twenty years, and have resulted in significant cost avoidance, safety improvements, and increased fleet readiness. State-of-the-art CBM-enabling technology has been focused on dynamic and high-cost systems. With current aircraft structural maintenance and inspection procedures being severely labor & material intensive across industry and defense platforms, and with new metallic and composite components being introduced, advancements in SHM technology has become an increasing priority for many military and commercial air-framers.

Technology Category Alignment:

Satellite Communications (SATCOM)

Robotics/Automated Material Handling Equipment

Shipyards/Shipbuilding

Supply; Storage

Satellite Communications (SATCOM)

Satellite Communications (SATCOM)

Supply; Storage

Supply; Storage

Satellite Communications (SATCOM)

Shipyards/Shipbuilding

Robotics/Automated Material Handling Equipment

Robotics/Automated Material Handling Equipment

Robotics/Automated Material Handling Equipment

Robotics/Automated Material Handling Equipment

Protection, Sustainment, and Warfighter Performance

Medical Chem-Bio Defense

Military Infectious Diseases

Propulsion and Extreme Environments

Fixed Wing Vehicles (includes UAS)

Survivability

Maintainability/Sustainability

Unmanned Ground and Sea Vehicles

Corrosion

Advanced Computing/Software Development

Networks and Communications

Modular/Open/Reconfigurable Architectures

RF Components for sensing, transmission and communication

Electronics Integration

Broadband/Multispectral Components and Systems

Sensors, Electronics and Photonics

Radio Frequency (RF) (non-EW)

Survivability

Broadband/Multispectral Components and Systems

RF Components for sensing, transmission and communication

Radio Frequency (RF) (non-EW)

Networks and Communications

Guidance, Navigation & Control (GN&C) and Data Links
RF Components for sensing, transmission and communication
Networks and Communications
Cognitive/Adaptive Capabilities
Preemptive/Proactive Effects
Broadband/Multispectral Components and Systems
Advanced Computing/Software Development
Networks and Communications
Personalized Assessment, Education, and Training
System Interfaces & Cognitive Processes
Aircraft Propulsion, Power and Thermal
Modeling, Simulation & Test Infrastructure
Rotary Wing Vehicles
Fixed Wing Vehicles (includes UAS)
Fixed Wing Vehicles (includes UAS)
Acoustic, Seismic and Magnetic
Rotary Wing Vehicles
Structures and Protection
Energy storage
Unmanned Ground and Sea Vehicles
Mobility
Power and Energy
Synthesis/Analytics/Decision Tools
Information Collection/Management
Advanced Computing/Software Development
Survivability
Unmanned Ground and Sea Vehicles
Radio Frequency (RF) (non-EW)
Power Generation/Energy Conversion
Energy storage
Power and Energy
Sensors, Electronics and Photonics
Maintainability/Sustainability
Advanced Computing/Software Development
EO/IR Components for sensing, transmission and communication
Microelectronics and Nanoelectronics
Networks and Communications
Mobility
Broadband/Multispectral Components and Systems
Sensors, Electronics and Photonics
Structures and Protection
Electro-Optical/Infrared (EO/IR)
Human/Autonomous System Interaction and Collaboration
Maintainability/Sustainability
System Interfaces & Cognitive Processes
Aircraft Propulsion, Power and Thermal
Power Generation/Energy Conversion

High Energy Lasers (HEL)
Propulsion
Biomedical Informatics / Health Information Systems & Technology
Protection, Sustainment, and Warfighter Performance
Modeling, Simulation & Test Infrastructure
Maintainability/Sustainability
Mobility
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Thermal Transport and Control
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RF Components for sensing, transmission and communication
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High-Speed/Hypersonics
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Acoustic, Seismic and Magnetic
Radio Frequency Weapons (RFW)
Electronic Materials
Electronics Integration
RF Components for sensing, transmission and communication
Electromechanical conversion
Energy storage
Power Control and Distribution
Power Generation/Energy Conversion
Thermal Transport and Control
EO/IR Components for sensing, transmission and communication
RF Components for sensing, transmission and communication
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Fixed Wing Vehicles (includes UAS)
Distributed/Coordinated/Net-Enabled Systems
High-Speed/Hypersonics
Propulsion and Extreme Environments
Energy storage
Ordnance
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Information Collection/Management
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EO/IR Components for sensing, transmission and communication
Rotary Wing Vehicles

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Modeling, Simulation & Test Infrastructure
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Assuring Effective Missions
Modular/Open/Reconfigurable Architectures
Personalized Assessment, Education, and Training
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Machine Perception, Reasoning and Intelligence
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Military Infectious Diseases
Military Operational Medicine
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Power Generation/Energy Conversion
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Propulsion
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Biomedical Informatics / Health Information Systems & Technology
Electro-Optical/Infrared (EO/IR)
High Energy Lasers (HEL)

EO/IR Components for sensing, transmission and communication
Networks and Communications
Sensors, Electronics and Photonics
Electro-Optical/Infrared (EO/IR)
Human Computer Interfaces (HCI) for Decision Making
Information Collection/Management
Synthesis/Analytics/Decision Tools
Human Aspects of Operations in Military Environments
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Microelectronics and Nanoelectronics

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Manufacturing Technology for Affordability
Manufacturing Technology for Affordability
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Electronics Integration
Propulsion and Extreme Environments
Readiness
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Fixed Wing Vehicles (includes UAS)
Machine Perception, Reasoning and Intelligence
Resilient Infrastructure
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High Energy Lasers (HEL)
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Scalable Teaming of Autonomous Systems
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Readiness

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Power Control and Distribution
Acoustic, Seismic and Magnetic
Fixed Wing Vehicles (includes UAS)
Aircraft Propulsion, Power and Thermal
Rotary Wing Vehicles
EO/IR Components for sensing, transmission and communication
Satellite Communications (SATCOM)
Networks and Communications
Trust Foundations
Electro-Optical/Infrared (EO/IR)
Unmanned Ground and Sea Vehicles
Maintainability/Sustainability
Modularity
Survivability
Electro-Optical/Infrared (EO/IR)
Sensors, Electronics and Photonics
EO/IR Components for sensing, transmission and communication
RF Components for sensing, transmission and communication
Networks and Communications
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Protection, Sustainment, and Warfighter Performance
Clinical & Rehabilitative Medicine
Combat Casualty Care
Medical Chem-Bio Defense
Energy storage
Protection, Sustainment, and Warfighter Performance
Human Computer Interfaces (HCI) for Decision Making
Synthesis/Analytics/Decision Tools
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Human Computer Interfaces (HCI) for Decision Making

Information Collection/Management
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Propulsion and Extreme Environments
RF Components for sensing, transmission and communication
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Energy storage
Manufacturing Technology for Affordability
Power and Energy
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Advanced Computing/Software Development
Trust Foundations
Integrating Architecture and Capability Demonstrations
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Mobility
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Propulsion
Protection, Sustainment, and Warfighter Performance
Individual Warfighter
Synthesis/Analytics/Decision Tools
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EO/IR Components for sensing, transmission and communication
RF Components for sensing, transmission and communication
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Electromechanical conversion
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Power Control and Distribution
Power Generation/Energy Conversion
Electronics Integration
Energy storage
Power Control and Distribution
Power Generation/Energy Conversion
Survivability
Fixed Wing Vehicles (includes UAS)
Networks and Communications
Energy storage
Power Generation/Energy Conversion
Unmanned Ground and Sea Vehicles
Electromechanical conversion
Energy storage
Power Control and Distribution
Power Generation/Energy Conversion
Thermal Transport and Control
Thermal Transport and Control
Protection, Sustainment, and Warfighter Performance

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Networks and Communications
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Structures and Protection
Aircraft Propulsion, Power and Thermal
Corrosion

Propulsion and Extreme Environments

Readiness

Sensors, Electronics and Photonics

Structures and Protection

Electronics Integration

Networks and Communications

None

None

None

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None

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2017-706

Topic # N10A-T042

Probability of Detection (PoD) Toolbox for Guided Wave based Structural Health Monitoring (SHM)

Metis Design Corporation

WHO

SYSCOM: NAVAIR

Sponsoring Program: Heavy Lift Helicopters Program (PMA-261)

Transition Target: CH-53K

TPOC:

(301)342-9428

Other transition opportunities: Rotorcraft & Fixed-wing airframe fatigue, corrosion, and impact detection; Aircraft & shipboard cargo deck monitoring; several commercial aircraft opportunities through United Technologies Corporation (UTC) technology license agreement.

Notes: Metis Design Corporation (MDC or Metis) has partnered with UTC Aerospace Systems (UTAS) for vehicle applications of Structural Health Monitoring. Metis and UTAS team members are active in leading efforts to earn military and commercial regulatory acceptance and validation.



http://www.navair.navy.mil/img/uploads/610_31701.jpg

WHAT

Operational Need and Improvement: There has been a twenty-year effort to improve vehicle health monitoring and assessments across commercial and military assets through condition based maintenance (CBM or CBM+). This technology has progressed, leaving a gap in structural (airframe) monitoring and operations. As emerging technologies improved feasibility of a robust and reliable design and many new metallic and composites were introduced, advancements in SHM capability and procedures have become a priority for many military and commercial air-framers. The implementation of a robust, reliable, and automated monitoring technology will lower maintenance costs and extend aircraft maintenance intervals and life expectancy.

Specifications Required: There are three high level system requirements: (1) The system must survive a high-altitude rotorcraft operational environment. (2) The system shall detect specified structural changes, of which could include corrosion, micro-cracks and fatigue precursors, and physical impacts. (3) Low system mass and integration difficulty.

Technology Developed: Metis has developed a SHM technique that utilizes a network of digital sensors to monitor physical changes in critical structural components. The patented technique utilizes passive and active ultrasonic monitoring techniques to detect fatigue crack initiation and growth, corrosion, and/or impact events. The MD7-Pro SHM system utilizes piezoelectric elements for transmitting and receiving ultrasonic waves across a material, and a microprocessor that controls the scanning routines and manages the collected data. A central data accumulator controls the synchronization and structural health assessment by collecting these datum and comparing the structural characterization from each scan routine to the baseline of the "healthy" structure.

Warfighter Value: The implementation of a robust, reliable, and automated monitoring technology will improve safety, lower maintenance costs, and extend aircraft maintenance intervals and life expectancy. The MD7-Pro SHM technology is more mature, lighter weight, more easily integrated, and can monitor for more damage conditions than any competing SHM technology.

WHEN

Contract Number: N68335-17-C-0184 **Ending on:** August 10, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
3D APL Prediction for Single Sensor in metallic structures	Low	Probability of Detection (POD) compare to Navy test case	5-6	July 2017
3D APL Prediction for Multiple Sensors	Low	PoD compare to Navy test case	5-6	December 2017
3D APL Prediction for Multiple Structural Layers	Med	PoD compare to Navy test case	5-6	June 2018
Final Reporting & Documentation	Low	Technology progression, quality of work, and value to future programs	5-6	August 2018

HOW

Projected Business Model: Metis is soliciting retrofit and production programs that aim to lower maintenance costs, and increase safety and fleet readiness. Defense customers with HUMS-equipped aircraft are prime targets, as there are existing CBM operations and ease of SHM integration; however, the MD7 system can be installed as a stand-alone system as well. The UTAS partnership will provide certification and manufacturing support, as well as a distribution outlet for all vehicle applications.

Company Objectives: Metis is a technology development company with primary locations in Boston, MA and San Francisco, CA. Metis has been successful in development, maturation, and securing commercial licensing agreements for our patented SHM and Anti-Ice technologies. Metis' size and agility have been critical attributes in our ability to convert funding opportunities to technology while compelling thought leaders across industries to become supporters and early adopters. Primary goals for 2017 are to identify and secure funded development programs for Metis Power Generation technology, and advanced demonstrations of Metis SHM and Anti-icing technologies on additional platforms.

Potential Commercial Applications: Metis and UTC Aerospace Systems have engaged with a number of commercial aircraft manufacturers and fleet owners to understand entry requirements and feasible implementation plans for commercial fixed wing and rotorcraft programs. The demand for this technology on commercial aircraft relies heavily on regulatory acceptance.

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