Structural Health Monitoring of Naval Assets

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SYSCOM: Naval Air Systems Command (NAVAIR) | *www.navair.navy.mil*

Program Sponsor: PMA-262

Other Potential Programs: PMA-261, any aircraft, ship or submarine

Current TRL: 7

Projected TRL: Flight Test completed, awaiting test results and introduction to fleet in Phase III

Keywords: Structural Health Monitoring, SHM, Condition-Based Maintenance, CBM

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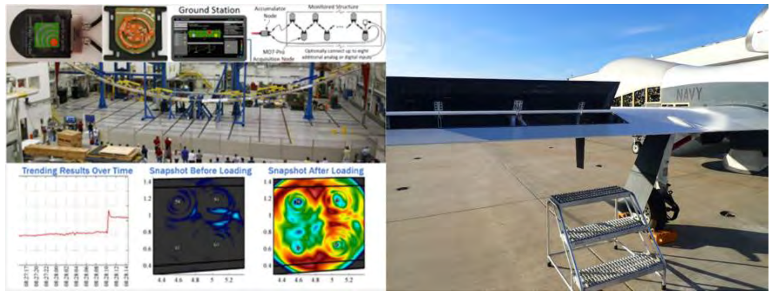

THE CHALLENGE

Aircraft have historically been subject to damage tolerant design, wherein assets must be taken out of service on a fixed schedule for tear-down manual inspection. This process is time consuming and expensive, driving up cost and adversely affecting asset availability, particularly as structures age. As the DoD moves towards Condition Based Maintenance (CBM), new and more efficient approaches are sought to sustain aircraft at lower cost with less impact to availability.

THE INNOVATION

Structural Health Monitoring (SHM) implies the permanent integration of non-destructive evaluation (NDE) hardware to enable on-demand integrity state awareness. SHM systems can be optimized to cover wide areas or focus on specific “hot-spots”. They are configured to monitor adverse changes from an installed condition, such as fatigue cracks, corrosion, delamination, loose fasteners or impacts. Metis Design Corporation (MDC) has developed a fully digital SHM solution. The MD7-Pro system is composed of three core elements: an Accumulation Node for remote data concentration, daisy-chainable Acquisition Nodes for distributed signal digitization, and piezoelectric-based ultrasonic Structural Sonar Arrays. From a single node, a meter radius damage map can be generated using an active guided wave scan or the acoustic response from an impact event can be passively captured.

THE NAVY BENEFIT

Benefits of SHM include drastically reducing manual inspection costs, minimizing preventative maintenance, increasing asset availability, and extending remaining useful life of components. Specific to MD7, the distributed infrastructure provides for higher fidelity data through digitizing signals at the point of measurement, reduced computational burden through local processing, and overall minimal mass through the consolidation of cables and elimination of centralized hardware. PMA-262 has estimated that by using 200 MD7 sensors to monitor bondline integrity between composite wing skin and spars, significant sustainment costs can be averted throughout the life of the MQ-4C fleet in addition to an increase in aircraft availability.

THE FUTURE

MD7 sensors have been thoroughly tested to characterize detection reliability and airworthiness and have participated in MQ-4C full-scale fatigue testing for over five years in addition to recent flight testing. Similar tests have been conducted in support of the CH-53K for monitoring fatigue cracks in gearbox mounts. MDC is seeking further transition opportunities for aircraft, ship or submarine structural monitoring.