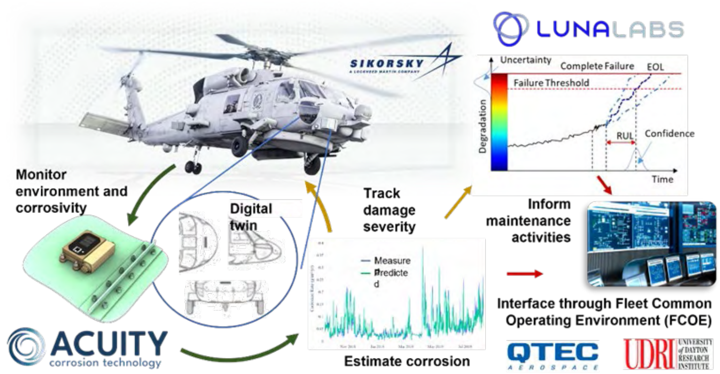
Approved, DCN# 543-742-23 20230720

Digital Twin Technologies for Airframe Corrosion



Luna Labs USA, LLC
Charlottesville, VA
www.lunalabs.us

Contact:
Rebecca Marshall, PhD
Corrosion Scientist
Luna Labs USA, LLC
rebecca.marshall@lunalabs.us

Topic Number: N202-105

SYSCOM: Naval Air Systems Command (NAVAIR)

Program Sponsor: NAWCAD

Other Potential Programs:
PMA 261 CH-53 heavy lift, PMA 299 HH-60 multi-mission helicopters, PMA 207 C/KC-130 tactical aircraft, PMA-265 F/A-18 and EA-18G

Current TRL: 5
Projected TRL: 7 / Q3 2025

Keywords:
Machine learning, digital twin, corrosion, maintenance, prediction, aircraft, environmental severity

SBIR Innovation Center

2023 Navy Gold Coast | Jul 26 – 28, 2023

THE CHALLENGE

Naval aircraft operate in a wide range of environmental conditions that result in variable corrosion severity over the aircraft service life. Corrosion is managed by set cleaning and inspection schedules according to general and aircraft specific technical manuals. During scheduled preventative cleaning and inspection, the discovery of corrosion damage necessitates unscheduled corrective corrosion maintenance. Aircraft usage, environmental conditions, and corrosion severity can influence the amount of corrosion maintenance and repair that will occur on an individual aircraft at each maintenance level.

THE INNOVATION

Given the significance of corrosion management for aircraft capability and achieving operations and support (O&S) goals, maintenance models based on corrosion severity would support optimization of preventative maintenance processes to reduce unscheduled maintenance and corrosion repair. Therefore, the proposed solution leverages machine learning (ML) techniques to create a digital twin framework, allowing optimized sensorization for CBM+ and predictive corrosion maintenance. Results have indicated well-performing models on HH-60, CH-53E, and C-130 aircraft.

THE NAVY BENEFIT

The expected benefits from the ML algorithms are to help evaluate existing corrosion prevention processes and inform recommendations for new predictive maintenance practices. Informed maintenance can improve efficiencies in identifying and responding to corrosion issues, and reducing costs, maintenance labor hours, and days of non-availability. The objective of this work is to satisfy the Navy's goal to enhance operational readiness and improve sustainment to meet O&S and capability goals. The measurement systems and environment and corrosion severity models have been successfully evaluated through this project and related programs in relevant environment tests to reduce technical risk. The technology maturation and implementation are being funded via a combination of SBIR and non-SBIR projects, and Luna Labs is investing in the corrosion product portfolio.

THE FUTURE

Standardization and integration with the Fleet Common Operating Environment (FCOE) and Integrated Vehicle Health Monitoring Systems (IVHMS) will continue to be pursued as future paths for implementing the technology. In addition, communication will continue with Program Offices to extend the physical and virtual sensing technology and corrosion severity models to additional aircraft systems for individual aircraft tracking and fleetwide maintenance processes. Technology transition and Phase III opportunities will be pursued with multiple Program Offices and other DoD components.