Conformal Load-bearing Antenna Structures (CLAS)

PROBLEM / OBJECTIVE

The conventional VHF blade antenna is prolific on both commercial and military 737 variants providing a necessary communication and navigation link. It is commonly found on a number of military aircraft such as AWACS, EPX, and P8-A. The blade antenna typically extends from the belly of the aircraft about 12 inches and weighs about 5 pounds. In addition, the blade antenna requires structural modifications and mounting provisions that add weight to the aircraft. The weight and profile of the blade antenna has an adverse affect on performance and operation costs.

- Drag disrupts the airflow, leading to reduced vehicle speed and fuel efficiency.
- Damage commonly due to collisions with runway debris and ground equipment decreases the mission availability of the aircraft.

These issues along with the technical maturity of "spray-on" or Direct Write (DW) type of antennas has lead to investment to advance the manufacturing maturity of DW Conformal Load-Bearing Antenna Structures (CLAS). The DW CLAS antenna is conformal to the aircraft surface, does not protrude from the aircraft, requires no mounting provisions, and can replicate the RF signature of the blade antenna. As a result, the DW CLAS antenna mitigates the aforementioned issues with the blade antenna, making it an attractable alternative. However, DW CLAS manufacturing and technology needs to be matured to be a viable replacement for the conventional antenna. Challenges include overspray, material and substrate compatibility, material conductivity, RF properties, and connectors to connect the sprayed antenna element to the back-end hardware.

Direct Write Antenna

ACCOMPLISHMENTS / PAYOFF

The Defense-Wide Manufacturing Science and Technology Program (DMS&T) and the Air Force Research Laboratory's (AFRL) Materials and Manufacturing Directorate established a program to identify and resolve the producibility issues with DW CLAS. Mesoplasma Thermal Spray (MST) was the primary DW technology to be improved, as well as, the methodology and hardware required to integrate this technology into existing honey comb composite structure. MTS was selected due to its ability to deposit features ranging from inches to microns-wide over large areas including conformal surfaces as required for antennas. The goal was to develop a fully deposited, highly durable, structurally integrated antenna element that will replace an existing parasitic blade antenna.

Expected Benefits and Warfighter Impact:

The program demonstrated a manufacturing readiness level of 5 through production of a DW CLAS antenna on a wing-to-body fairing with a compliant RF response. Additional environmental and flight testing is required to certify the antenna as a replacement for the VHF blade antenna. The program achieved the following benefits:

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- The knowledge base for simulation of CLAS antennas was increased, providing a better modeling capability comprehending the effects of DW materials, substrates, and the profile on the conformal surface to realize the desired RF signature.
- Alternative materials were developed with a lower dielectric constant to reduce the deposition (spray) time of the strip-line by 74%.
- Reduced overspray of the intended line from 4X to 0.3X.
- Improved line quality / edge definition by 25%.
- Improved copper resistivity by 70% reducing the amount of copper required, thereby reducing costs by requiring less material and time for production.
- Developed a through-hull connector suitable for connecting the DW antenna element on the outer mold line of the aircraft to the ground plane and strip-line on the inside of the wing-to-body fairing.
- Identified a commercial connector and developed a mounting system for connecting the strip-line to the back-end hardware through a traditional coax cable.

POINT OF CONTACT

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