Air Force SBIR/STTR

Air Force SBIR/STTR Transition Story

Transition

An example of Air Force supported SBIR/STTR technology that has been transitioned into an Air Force or other DoD system or subsystem or used by Air Force test ranges and facilities or maintenance depots.

SBIR Topic Number:
AF02-282

SBIR Title:
Inspection of Aircraft Composite Components

Contract Number:
F09650-03-C-0035

SBIR Company Name:
QUEST Integrated, Inc., Kent, WA

Technical Project Office:
Warner Robins Air Logistics Center, Robins AFB, GA

Induction Thermography System Inspection at Robins AFB, Georgia

Portable Thermal Analysis Microscope

- The Air Force needs a system that allows a rapid and in-situ scan of the vertical stabilizers on aircraft to determine if removal is required
- QUEST Integrated, Inc., developed the Induction Thermography System (ITS™) which operates by inductively heating the aluminum honeycomb at the bond interface with a radio frequency (RF) wand
- The ITS™ technology has been credited with saving an F-15 vertical stabilizer that had been condemned by a tap test, with the cost savings of this one incident alone more than offsetting the SBIR funding investment
- NASA has purchased two systems, and two major contractors have purchased units for testing the next generation of composite-based commercial aircraft

Commercialization Pilot Program Series

EN 10-002

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Air Force Requirement

The use of composite materials has improved the performance and capabilities of modern military aircraft. One structure of particular concern is the vertical stabilizer of the F-15 aircraft, with the bonding between the boron/epoxy skin and the aluminum honeycomb being known to degrade over time. These stabilizers are being inspected in-situ using a conventional "tap" test method. Once a suspect damaged stabilizer is found, it is removed for a detailed ultrasonic inspection. Unfortunately, the tap test is subject to human error and has problems achieving 100% inspection coverage. Removing the vertical stabilizer for ultrasonic testing is an expensive and time-consuming task that reduces the availability of the aircraft.

The Air Force needs a system that allows a rapid and in-situ scan of the vertical stabilizers to determine if removal is required. The system should be used for flight-line inspections in the field, as well as at the repair depot.

SBIR Technology

In this SBIR project, QUEST Integrated, Inc., developed the Induction Thermography System (ITS™) which operates by inductively heating the aluminum honeycomb at the bond interface with a radio frequency (RF) wand. Properly bonded honeycomb panels transfer part of the heat, by conduction, to the boron skin. A sensitive infrared camera is used to image the temperature distribution of the skin. Disbonds do not conduct heat, and appear as "cold" or dark spots that are easily detected on the thermal images, and can be marked with a conventional grease pencil on the skin. These areas can then be inspected in detail using a tap test or other non-destructive inspection (NDI) method.

QUEST developed a custom RF power supply that is portable and delivers 2 kW of RF energy in a small lightweight package. In addition, the RF wand is ergonomically designed to allow the operator to use it on vertical surfaces, as well as upward or downward facing horizontal surfaces with comfort, over an extended period of time. Along with the heating system, the ITS™ includes an infrared camera, laptop computer, and software for image enhancement and archive reporting of the results.

Transition Impact

The ITS™ technology has already been credited with saving an F-15 vertical stabilizer that had been condemned by a tap test. The ITS™ inspection contradicted the original findings and alerted the NDI team to re-examine the vertical stabilizer which was found to be sound. The cost savings of this one incident alone more than offset the SBIR funding investment. In addition, the system has proven to be useful in verifying the structural integrity of boron laminate patches used to repair bullet hole damaged skins. The ITS™ can visualize the final placement of the patch over the hole, and indicate which parts of the patch have poor adhesive bonds to the underlying skin.

The ITS™ heating concept can be applied on any electrically conductive reinforcement or element within or in contact with a composite structure. NASA has purchased two systems. One unit at the Jet Propulsion Laboratory in Pasadena, California, is being tested for verifying the integrity of rocket fuel tanks for deep space probes. These tanks are composed of carbon-wrapped titanium shells of extremely thin sections. Here, the integrity of the bond between the carbon-wrap and the titanium skin is critical for the tank's long-term performance. NASA Langley is evaluating the ITS™ for testing various components on the space shuttle. In addition, Boeing and Airbus Industries have purchased units for testing the next generation of composite-based commercial aircraft.

Company Impact

This SBIR program has enabled QUEST to offer a complementary NDI tool to their Magneto-Optical Imager (MOI™) system for aircraft inspections. The MOI™ is used by the Air Force and commercial companies for inspecting cracks in riveted aluminum airframes, and is widely acknowledged to be the only system capable of rapidly scanning large areas for flaws. With the addition of the ITS™ product line, QUEST is well positioned to support the transition of airframes from aluminum structures to composite structures that will mark the most significant advance in airframe technology in the 21st century.

U.S. AIR FORCE

SBIR/STTR

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