THE Ames Laboratory

Creating Materials & Energy Solutions

Tools for Inspecting Aircraft Components

- Methods developed for performing advanced experiments in the laboratory find applications in aircraft safety assurance.
- Developed in a Basic Energy Sciences project at the Ames Laboratory.
- The system is now widely used in other industries for quality assurance.
- Essential tool for critical structural components in many applications.

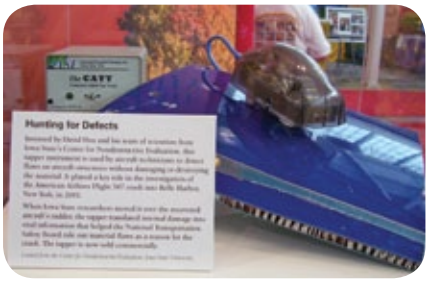
In the 1980s and early 1990s, BES supported work related to the ultrasonic characterization of microstructure, with one motivation being the creation of the scientific foundation for improved techniques to gain more information about microstructural evolution during mechanical tests and providing a foundation for improved process control tools during manufacturing.

The work had a number of thrusts, including magnetic measurements, linear ultrasonic measurements to characterize grain structure, nonlinear ultrasonic (i.e. harmonic generation) characterization of mechanical properties (including fatigue), and ultrasonic studies of fatigue crack closure and its effect on crack propagation. Much ongoing work around the world today has been influenced by the results.

This work also provided the scientific foundation for a significant advancement in the inspection of aircraft engines. The Sioux City, Iowa, crash of a DC10 in 1989 was caused by the rupture of a titanium rotor disk in a large jet engine, severing hydraulic control lines in the fuselage, and leading to a crash landing that killed over 100 people. This occurred because there was no means to detect the metallurgical defect that initiated the fatigue process.

The accident caused the FAA to re-examine its engine inspection protocols, and a procedure was adopted for detecting cracks as small as 200 microns in a titanium disk a few feet in diameter, using a new phased array ultrasonic transducer.

This method was directly based on the BES-funded work at the Ames Laboratory, and since its adoption no similar incident has occurred, despite the accumulation of millions of hours of flight with similar engines.



Equipment capable of testing aircraft components for structural flaws without damaging or destroying the part being tested is now available commercially thanks to research at Ames Laboratory.

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