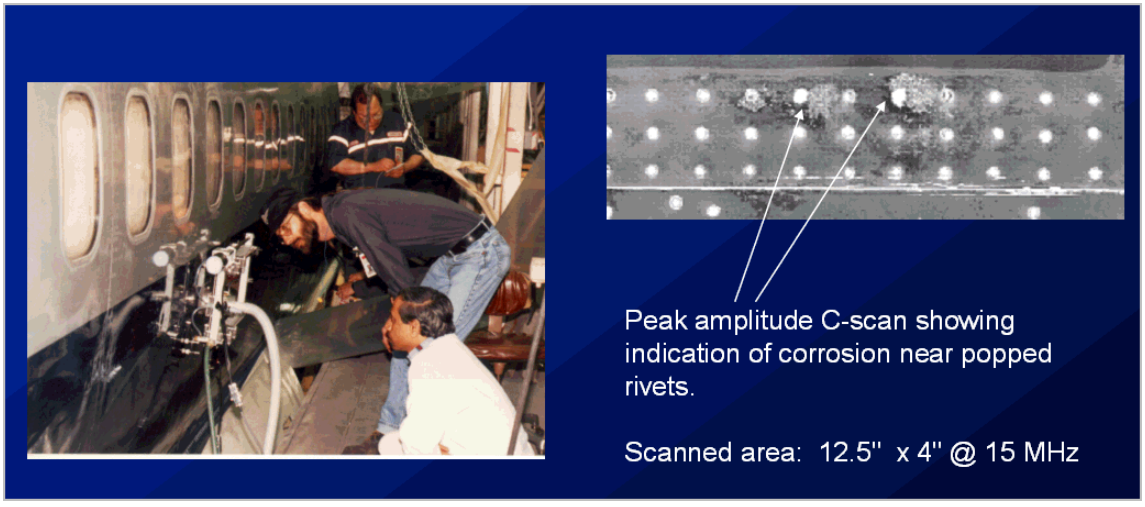
Center for Nondestructive Evaluation (CNDE)

Iowa State University
Dr. R. Bruce Thompson, Director
Phone: 515-294-7864
E-mail: thompsonrb@cnde.iastate.edu

Professor David Hsu
Phone: 515-294-2501
E-mail: dhsu@cnde.iastate.edu

Dripless Bubbler: Portable Scanner for Aircraft Inspection

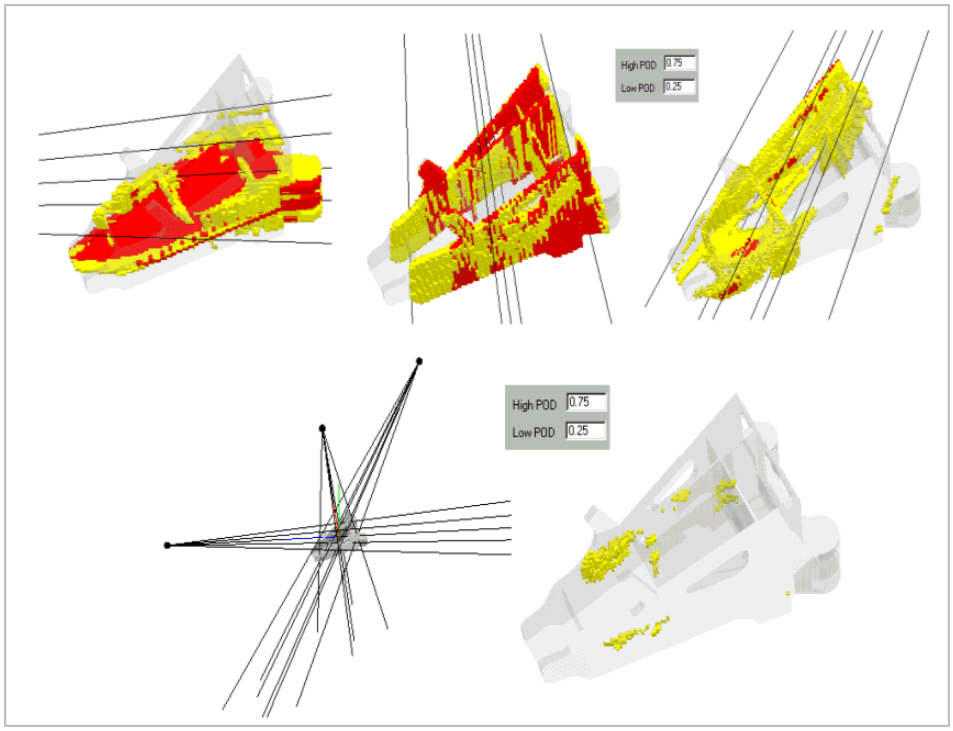
The Center for Nondestructive Evaluation (CNDE) has developed a fieldable ultrasonic scanning system for aircraft inspection. It was developed by the Composite Group of CNDE, led by Prof. David K. Hsu. The "Dripless Bubbler" is the first portable ultrasonic scanner with a closed-cycle water couplant and uses high frequency focused ultrasonic beam. It is a portable ultrasonic scanner designed and developed for aircraft inspection. It can be attached to the fuselage of an aircraft and inspect it for hidden corrosion. It uses a unique closed-cycle pump/vacuum water handling system that allows the use of focused transducers. The focused ultrasonic beam leads to superior image resolution and more accurate determination of the metal loss due to corrosion. It has the unique capability of scanning over protruding rivets on the aircraft skin. The closed-cycle water handling feature makes it compatible with the safety requirements of maintenance hangars.



Above: Dripless Bubbler Field Demo at NWA- Corrosion Detection on Boeing 747

Because this device performs ultrasonic inspection with a focused beam, it provides much improved resolution and sensitivity compared to previous methods. The resolution afforded by the focused transducer makes it a useful tool for mapping out the depth profile of corrosion. The Dripless Bubbler received an R&D100 award. The Dripless Bubbler was licensed to and commercialized by Sierra Matrix, Inc. of Fremont, California. The technology was used in addressing the corrosion problem of KC135 wing skins around fasteners. For more information, contact professor David K.Hsu, 515-294-2501; e-mail: dhsu@cnde.iastate.edu.

Simulation Tools for Nondestructive Evaluation

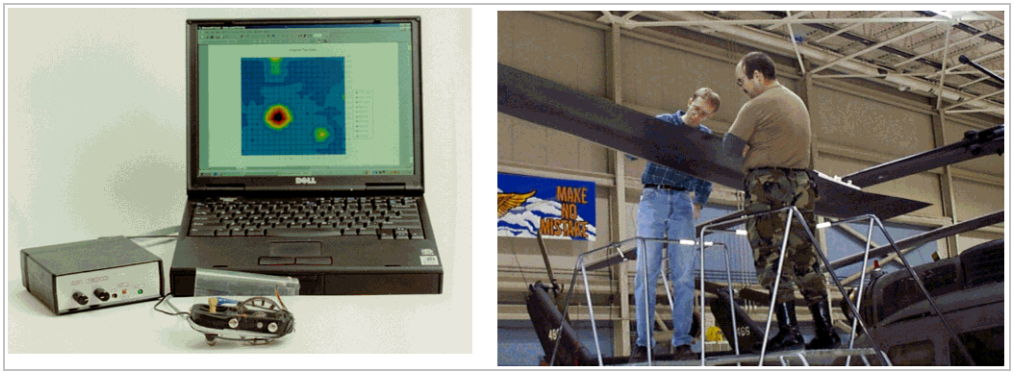


Simulation tools have been developed that make it possible to predict the results of nondestructive evaluation (NDE) measurements to detect and characterize flaws in structural materials. These incorporate rigorous, physics-based models, and procedures to determine the necessary input parameters to describe the measurement situation and user interfaces. The tools include simulators for ultrasonic, eddy current, and x-ray NDE. The tools result in considerable industrial cost and time-savings, since the need to construct expensive samples and make time-consuming measurements on them is greatly reduced. Many possible inspection scenarios can be quickly evaluated, leading to a down-selection of a few for final experimental evaluation. The technology has been transferred to a number of major OEMs with large industrial impact. A major, land-based gas turbine manufacturer saved $500K per year in avoiding the manufacture of curvature correction blocks. A consortium of aircraft engine companies are using these tools to design the ultrasonic probes used to inspect billet and forging materials for critical defects. One aerospace company has estimated that a particular ultrasonic application saved them $1M in the first year alone and is investing a like amount at CNDE to develop other possibilities. Eddy current simulators are being used in the nuclear, aircraft engine and general aviation industries to evaluate the capabilities of a wide range of inspection techniques. A small business, NDE Technologies, was formed in 1997 to commercialize the technology. A joint agency group (Air Force, FAA, NASA) has recognized the important potential of this technology to replace, to a large degree, costly and time-consuming

experimental programs for assessment of NDE reliability. For more information, contact R. Bruce Thompson, 515-294-7864; e-mail: thompsonrb@cnde.iastate.edu.

Time-Proven “Coin Tap” Automated

The hearing-based, manual tap test, practiced widely by aircraft inspectors, was computerized and automated to give it quantitative and imaging capabilities and to take the "human factor" variation out of the inspection procedure. The tapping action was automated with the invention of a magnetic cam-action cart. Equally-spaced and uniform taps were made as the cart was pushed over the part's surface. The simple encoding method gave the system a previously unavailable imaging capability. Computer-aided tap tester (CATT) has proven effective for the inspection of both composite structures and metal honeycomb structures on a wide variety of control surfaces on aircraft. It also provided the quantitative inspection results in the form of images that can be archived electronically. The technology was patented and licensed to a start-up company, Advanced Structural Imaging, Inc. in 2001. Two of the original inventors of the CATT participated in the company. Aircraft manufacturers and R&D organizations in NDE have purchased ten units from the company so far. For additional information, contact David K. Hsu, dhsu@cnde.iastate.edu.



Left: The CATT system. *Right*: Inspecting a Black Hawk rotor blade with CATT.