

Sensors

## Floating Ultrasonic System

Nondestructive inspection of surfaces without an external liquid couplant

NASA's Langley Research Center has developed a Floating Ultrasonic System for improved nondestructive testing. Most ultrasonic scanners require an external liquid coupling agent (e.g., water, gel, oil) to make a good contact between the probe and the surface being scanned. However, some surfaces are sensitive to moisture and/or contamination created by these agents. NASA created the Floating Ultrasonic System to address this issue. NASA's technology is based on a momentary touching scheme where a vibrating probe comes in contact with the structure for fractions of a second while performing measurements, giving the probe the appearance of floating across a surface. The design allows for the easy movement of the probe over surfaces being inspected without the use of a liquid couplant between the probe and the surface. Initial test results have also shown NASA's system to have comparable performance to liquid-couplant-based, ultrasonic scanners.

National Aeronautics and  
Space Administration



### BENEFITS

- ➔ No external liquid couplant needed - does not require liquid or gel coupling materials between the probe and surface being scanned
- ➔ Multipoint scanning in the XY plane - does not have limitations with freedom of movement
- ➔ Improved inspection - permits easier and faster movement of the probe across the test surface (due to reduced friction)
- ➔ Versatile - can be used to scan a variety of materials, including composites and metals
- ➔ In situ - will allow for in-place inspection of surfaces and will significantly simplify inspection, especially for vertical or overhead surfaces
- ➔ Cost competitive - is anticipated to be comparable in cost to other ultrasound techniques

technology solution

### THE TECHNOLOGY

NASA's Floating Ultrasonic System includes a transducer assembly with a flexible membrane tip made of nitrile rubber. A small amount of gel couplant is layered between the transducer and the inside of the membrane; the gel is fully contained inside the probe and does not come into contact with surfaces being inspected. The transducer assembly is mounted to a voice-coil motor that acts as an actuator. Electrical current sent to motor moves the transducer up and down over the surface being inspected. The vibrating, or floating, transducer design provides two critical functions. First, it applies a small force that enables coupling of the ultrasonic energy from the transducer to the surface being inspected. Second, it facilitates movement of the transducer across the surface. A diagram of NASA's Floating Ultrasonic System is presented in Figure 1(a). NASA has constructed a bench-top unit that has undergone successful testing. Figure 1(b) shows ultrasonic C-scan images of a composite plate using both NASA's Floating Ultrasonic System and a traditional watertank-based scanning system. NASA's system provides comparable results, but unlike the water-tank system, it allows for inspection without the use of an external liquid couplant. NASA researchers are working on additional refinements to the technology, including improving resolution, and plan to develop it into a handheld device. The technology will be used for the in-situ inspection of composite aerospace parts that are undergoing fatigue testing.

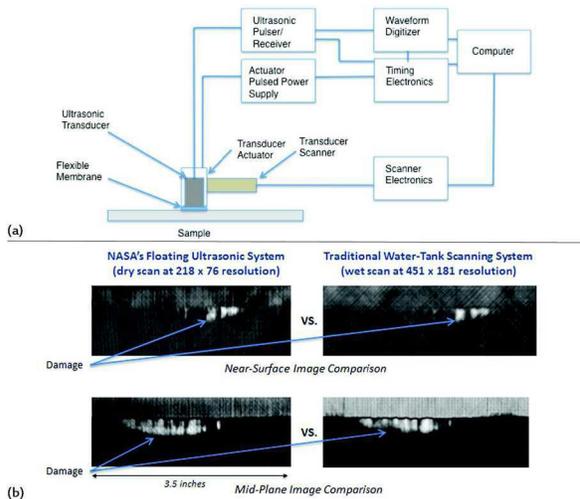


FIGURE 1 - (a) Diagram of NASA's Floating Ultrasonic System, (b) C-scan images of a composite part - NASA's Floating Ultrasonic System (unfocused transducer at 5MHz) on left vs. traditional water tank scan (focused transducer at 10MHz) on right

### APPLICATIONS

The technology has several potential applications:

- Aerospace - inspecting manufactured or in-service aerospace parts
- Aviation - inspecting structural health of vehicles
- Automotive - assessing durability and damage tolerance of metallic or composite parts
- Medical - imaging soft tissues such as internal organs and muscles
- Oil and gas - inspecting pipelines and other distribution/storage infrastructure

### PUBLICATIONS

Patent Pending

National Aeronautics and Space Administration

The Technology Gateway

Langley Research Center

Mail Stop 151

Hampton, VA 23681

757.864.1178

LARC-DL-technologygateway@mail.nasa.gov

<http://technology.nasa.gov/>

[www.nasa.gov](http://www.nasa.gov)

NP-2014-09-1271-HQ

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LAR-17211-1

