NASA Langley's
New Probe for Detecting Deep Flaws in Structures

Handheld probe for nondestructive evaluation of deep subsurface cracks

NASA Langley has developed a new nondestructive evaluation probe to detect small fatigue cracks prior to the onset of widespread fatigue damage. The detection of deeply buried fatigue cracks in thick multilayer structures like airplane wings continues to be a challenge for the nondestructive evaluation community. This new technology leverages the low frequency magnetic field sensitivity of giant magnetoresistive (GMR) sensors to identify subsurface cracks up to 1 cm deep. The handheld probe has been tested, and NASA Langley is seeking partners to license and commercialize it.

Benefits

- Non-invasive: Enables inspection of cracks initiated from deep fastener holes without removing the fastener (which can be costly and damaging)
- Effective: Capable of measuring flaws to a depth of up to 1 cm below the surface
- Multilayer capability: Compared to ultrasound methods, there are no issues with wave reflection at the layer interfaces
- Highly sensitive: Compared to other eddy current methods, the magnetoresistive sensors do not lose sensitivity at low frequencies (less than 100 Hz)
- Room-temperature operation
- Small package size

partnership opportunity

Langley Research Center

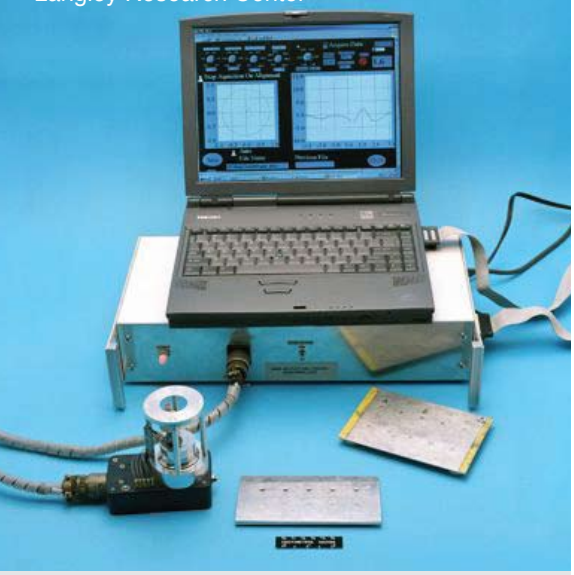

Figure 1: GMR-based rotating probe system

Applications

The technology offers wide-ranging market applications, including:

- Aerospace inspections:
  - fatigue cracks initiated from fastener holes without removing the fastener (which can be costly and damaging)
  - airframe: aging or stressed aircraft
- Civil structures: non-ferromagnetic bridges
- Manufacturing process control and quality assurance
- Chemical and petroleum manufacturing equipment to reduce plant operating costs

The Technology

The handheld GMR flux focusing eddy current probe, pictured in Figure 1 with the data system, detects deep flaws in thick multilayered conductive materials. The probe uses an excitation coil to induce eddy currents in the material. A GMR sensor, surrounded by the excitation coil, is used to detect generated fields. A highly permeable flux focusing lens is located between and separates the coil and the GMR sensor, producing a high flux density at the outer edge of the GMR sensor. By adjusting the drive frequency, and knowing certain material properties of the test specimen, one can calculate the magnetic field depth. The magnetic field changes in the proximity of subsurface cracks.

A prototype of the GMR probe has been developed and thoroughly tested jointly by NASA and the Department of Defense as part of an anti-aging aircraft program. Figure 2 shows the output from a test to detect a buried flaw in a layered sample. The GMR sensor has been tested against other probes on wing spar joint fasteners and found to outperform the others, particularly at low frequencies.

U.S. Patent 6,888,346

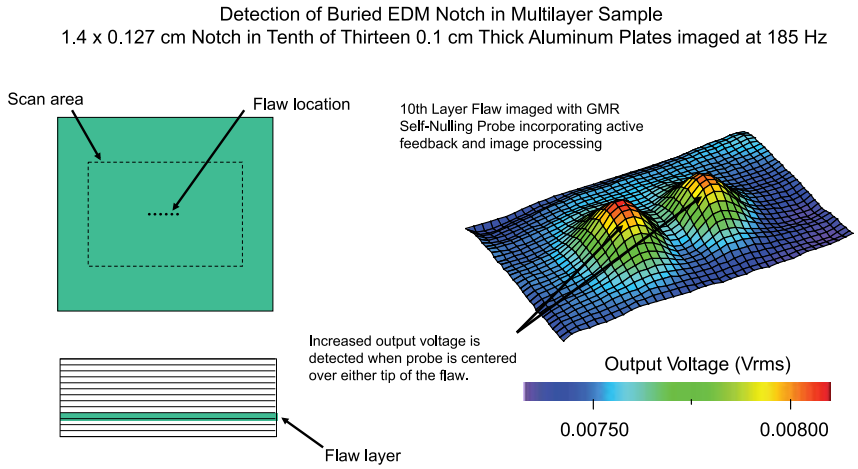

Figure 2: Deep Flaw Detection with GMR Based Self-Nulling Probe.

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

The Technology Gateway

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