



Non-Confidential Description
Novel Low-Cost Miniaturized Structural Health Monitoring Circuit

Technology Case: RFT-195

Invention Summary

Scientists at North Dakota State University have developed a unique, low-cost, miniaturized and highly-effective structural health monitoring (SHM) circuit that monitors a structure's integrity using a piezoelectric patch. The invention eliminates the use of traditional bulky equipment, thereby saving on power, space, and cost.

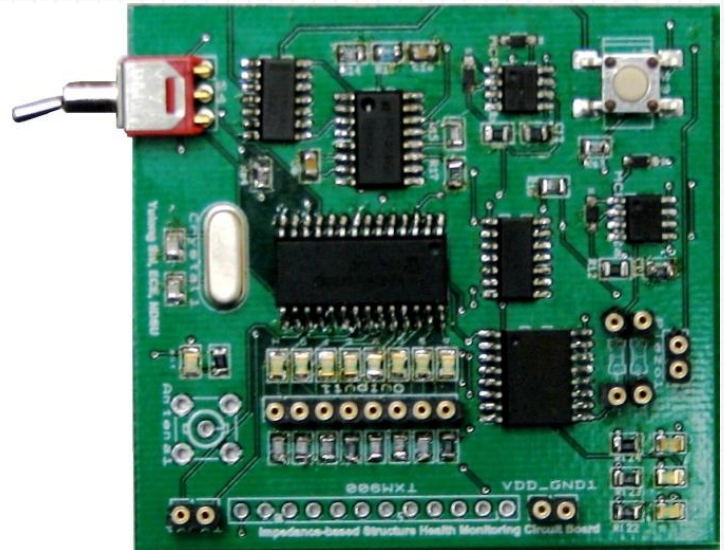


Figure showing impedance-based structural health monitoring (SHM) circuit board (production-intent prototype, shown actual size).

A silicon IC version of this same device could be made to be approximately 1 cm² in size (approximately the size of a dime)

Benefits

- Low cost of operation as compared with traditional methods using non-destructive evaluation (NDE) and non-destructive testing (NDT) techniques
- Very sensitive to small amounts of structural damage
- Non-intrusive and allows on-line health monitoring
- Can be used in inaccessible locations
- Localized sensing, unaffected by changes in boundary conditions, loading, or operational vibrations
- IC version of this device can use wireless power and alternative power sources such as solar
- Adaptable to wireless information transmission and RFID technology
- Incipient damage warning capability
- Very low cost of manufacture

Invention Premise

In piezoelectric materials, the mechanical and electrical impedances are coupled. The structural health monitoring circuit can detect damage when a piezoelectric patch attached to a structure is electrically excited. The piezoelectric patch senses electrical impedance variations caused from structural deformation or damage. Analyzing the electrical impedance

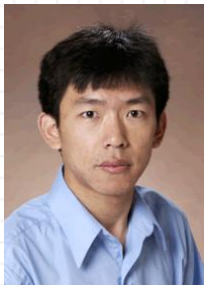
variations of the piezoelectric patch in the frequency domain makes it possible to detect the structural damage. This invention is based on a novel electronic circuit design which can generate a tunable frequency sweep, and a bridge circuit which measures changes in electrical impedance.

The implementation of impedance monitoring through electronic circuit method not only reduces the cost, but also contributes to the integration with self-power and wireless communication circuitry

Patents

This technology is patent pending and immediately available for licensing/partnering opportunities.

Lead Inventor



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Dr. You received his Bachelor of Science in Electrical Engineering from Nankai University in Tianjin, China, and Master of Science degrees in both Electrical Engineering and Management from the Rensselaer Polytechnic Institute in Troy, NY. He received his Ph.D. in Electrical Engineering from Rensselaer in 2005 before coming to teach at North Dakota State University. Dr. You's research interests include structural health monitoring, field-programmable gate arrays, very large scale integration (VLSI) design, and radio frequency identification (RFID) systems.

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