Failure Prediction of Complex Structures Under Loading and Environmental Stress

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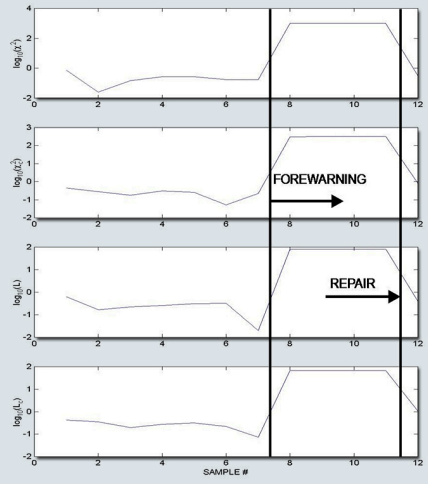

Forewarning of failure in a room-sized machining center

Technology Summary

ORNL researchers invented a software solution for monitoring complex structures such as buildings, bridges, and aircraft. This type of predictive tool is critical not only to assure structural safety, but also for cost effective life-planning for structure replacement. A variety of complex structures, such as aircraft, automobiles, bridges, buildings, ships, and spacecraft, can be analyzed with this tool. The invention falls within a growing portfolio of technologies collectively known as structural health monitoring.

Structures of any kind are subjected to a variety of stresses that will ultimately result in failure of an element of the structure. Tensile or shear stresses result from applied loads; environmental corrosion is another significant stress factor. The combination of these stresses results in cracks that grow and spread throughout the structure. The proliferation of cracks eventually causes the structure to fail. This invention offers a way to monitor crack growth and determine when cracks threaten structural integrity.

The invention's method involves acquiring time serial data from sensors on a structure and then using the invention's software to analyze stresses and strains, discover crack formation, and predict failure timing. The tool also draws upon known relationships among different materials and how they exhibit crack growth. This method can be used to reduce the labor and material costs of inspecting complex structures, and it offers near real-time prediction of failure.

Advantages

- Reduction of inspection time
- Deferred maintenance/repair
- Increased safety
- Near zero false-alarm rates
- Reduced design margins

Potential Applications

- Aircraft
- Automobiles
- Bridges
- Buildings
- Ships
- Spacecraft
- Civil infrastructure
- Power generating plants
- Electrical systems

Patent

Lee M. Hively, Robert K. Abercrombie, and Frederick T. Sheldon, *Failure Prediction of Complex Structures under Arbitrary Time-Serial Loading Conditions,* U.S. Patent Application 12/548,206, filed August 26, 2009.

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