Licensable Technologies

Mobile-agent Based Wireless Sensing Network for Structural Health Monitoring (SHM)

Applications:

- Civil infrastructure
  - Dams, dikes, hydroelectric power plants, pipelines, canals, tunnels, ports, harbors, waterways, and marine terminals, etc.
- Manufacturing equipment
- Aerospace systems
- Mechanical equipment

Benefits:

- Reduces installation cost
- Minimizes labor costs associated with manual inspection
- Increases profits by reducing system downtime
- Avoids unnecessary replacement of components based on time-of-use
- Detects system damage before catastrophic failure
- May be deployed ad hoc
- Reconfigurable
- Includes cameras for visual inspection
- Avoids sending humans into hazardous environments

Contact:

Kathleen Herrera McDonald
(505) 667-5844
kathleen_m@lanl.gov

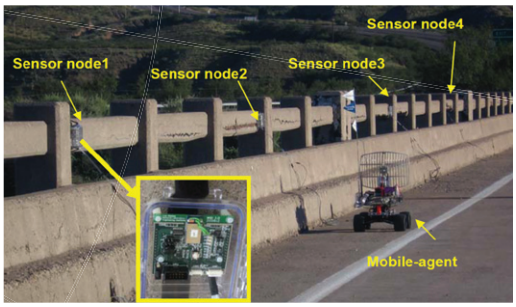
tmt-4@lanl.gov

Technology Transfer Division

Los Alamos NATIONAL LABORATORY ESTABLISHED 1943

Summary:

Structural Health Monitoring (SHM) has the potential to dramatically reduce lifecycle costs, extend the safe useful life of a structure, shrink insurance costs, decrease the need for expensive repairs, and circumvent complete failure of the monitored structure. In wired SHM systems, however, the cost of the wire itself can be a source of economic concern: While coaxial wires provide a reliable communication link, their installation and maintenance can be expensive and labor-intensive. Up to 25% of the total system cost and 75% of the installation time can be attributed solely to installation of systems cables. Structural monitoring systems installed in tall buildings have been reported in the literature to cost in excess of $5,000 per sensing channel, and the cost of the monitoring system does not scale linearly. The cost of installing over 600 sensing channels on the Tsing Ma suspension bridge in Hong Kong, for example, is estimated to have exceeded $16 million.



An unmanned vehicle interrogates and transmits energy to sensor nodes mounted along the rail of a bridge.

The issues associated with wired SHM systems, therefore, have generated significant interest in wireless SHM solutions, as they could facilitate lower-cost deployment of a greater number of sensors. However, the adoption of contemporary wireless SHM technology has been limited due in part to its associated power sources, which must be installed at fixed locations on the structure. These power sources (typically batteries) will eventually be depleted requiring periodic sensor network maintenance.

In response to these problems, Los Alamos National Laboratory (LANL) engineers have developed a mobile-agent based wireless sensing network for SHM. LANL's mobile-agent-based technology eliminates the disadvantages described above by integrating wireless energy transmission technology and remote interrogation platforms supported by unmanned vehicles to acquire the data necessary to assess damage in structural systems.

The mobile-agent, which can be an Unmanned Aerial Vehicle or ground robot (shown above,) generates a radio-frequency (RF) signal that is transmitted to receiving antennas connected to the sensor nodes embedded on the structure. The RF energy charges a capacitor on the sensor node that in turn provides power for measurements and wireless telemetry. The sensors monitor critical areas on the structure and transmit the measured signals back to the mobile-agent via wireless communications for subsequent near-real-time detailed analysis and classification.

The low cost of the sensor nodes and improved reliability achieved with the mobile agents makes the installation of potentially hundreds or even thousands of wireless sensors on a single structure economically feasible, which can greatly increase the damage detection capabilities of such monitoring systems. LANL's wireless monitoring system is better equipped to screen for structural damage by monitoring the behavior of critical structural components, thereby implementing much more local damage assessment than is currently done. LANL's system facilitates the wireless integration of sensor technologies while eliminating the shortcomings associated with embedded, finite duration power sources, allowing industry to fully realize the economic benefits of wireless SHM.

Development Stage: Working prototype

Patent Status: Patent pending

Licensing Status: Available for exclusive or non-exclusive licensing

www.lanl.gov/partnerships/license/technologies/