WiSys TECHNOLOGY FOUNDATION

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Health Monitoring and Imaging System for Concrete Structures

Market and Background

As of 2016, 39% of the total 614,387 bridges in the US had exceed their design lives. In China, almost 10% of its 779,159 bridges are classified as structurally deficient. Other countries in South America and Europe are facing similar challenges. With an estimated rehabilitation cost in the US alone estimated to reach $123 billion, the development and adoption of new technologies enabling early, non-destructive testing (NDT) of damage in concrete structures will be critical. Evidence of this increasing demand is the growing market for NDT equipment and inspection services, which is estimated to reach $26.4 billion by 2024. Currently, there are a number of NDT techniques on the market, however, they are either not sensitive to minor interior changes in concrete such as small cracking and stress changes, or not applicable to full-size structures on site. As such, there is a clear and unmet need for the development of a comprehensive system capable of generating images of the cracking, damage and subtle stress changes inside as well as on the surface of concrete structures.

Research and Development Status:

An assistant professor in civil engineering at the University of Wisconsin-Platteville in partnership with an electrical engineer from New Mexico State University, has developed a comprehensive monitoring system capable of identifying interior defects and stress in concrete structures such as bridges. By combining sensor technology with an ultrasound signal generator, multi-channel data acquisition and proprietary data processing algorithms, the interior conditions in any cross section of a bridge can be visualized in 3D. With this technology, small stress changes in the order of 0.1Mpa and cracks as thin as a human hair are detected. Such a combined system provides competitive advantage over existing methods that solely measure stress changes and rely on installation of strain gauges on the surface or inside concrete structures. These methods only provide for measurement of stress changes at the locations where sensors are placed, creating gaps in the evaluation of stress change. In addition, with current technology, holes must be drilled and patched for sensor placement and bridges must be taken out of service during testing. The proposed technology provides for a more absolute evaluation of not only changes in stress but also identification of cracks, does not require drilling of holes and can be used on in-service bridges, saving time, money and providing a more comprehensive assessment of bridge health.

Applications:

- Structural health monitoring and non-destructive testing for concrete infrastructures including bridges, buildings, mines, tunnels, dams and other earth structures

Key Benefits

- Capable of assessing large volumes of structures by using an array of installed sensors (no drilling required);
- Capable of detecting interior micro-defects (e.g. cracks) and weak stress changes with high degree of accuracy with in-service bridges (e.g. traffic does not need to be closed); and
- Capable of generating 3-dimensional images in real-time enabling the evaluation of damage level and stress change on site (for immediate damage) and over time (for health monitoring).

Intellectual Property:

A PCT application is pending for this technology. A fully functional prototype system has been developed and in-lab and in-field testing have been completed. For more information, please contact Jennifer Souter at jennifer@wisys.org or by phone at 608-316-4131.