Long Distance, Video Camera-Based Structure Monitoring  
Technology #18232

Applications

This technology measures the vibrations of structures from a long distance in an uncontrolled outdoor setting using a video camera. It can be used to measure the displacement of a structure for damage detection or be otherwise used in a change detection algorithm for the health monitoring of structures.

Problem Addressed

Large structures such as bridges, buildings and antenna towers are subject to rain and high winds among other environmental effects that can cause deterioration such as corrosion and metal fatigue. Monitoring the condition of these structures is critical to public safety; however, traditional means of infrastructure inspection, such as those that use wired accelerometers, are typically expensive and labor-intensive to use. The Inventors have developed an alternative method that uses a fast and simple camera set-up to track the resonant frequency and other properties of a structure’s displacement signal over time, to monitor signs of potential damage.

Technology

In this method, a video camera records a long video of a structure of interest under typical operational or ambient vibrations. A region of interest in the video is defined around the structure. At least two stationary objects outside the region of interest must also be in the video frame as references for motion compensation. In-plane displacements of the object are extracted from the video for both the structure of interest and other regions of the video. The displacement signals from the structure of interest are compensated for camera motion, and then can be initially analyzed in the time domain or frequency domain by averaging the signals. Then any detailed analysis for the condition assessment of the structure can be carried out using the measured displacement signals of the structure of interest. These methods for monitoring changes in the displacement signal can include statistical pattern recognition techniques, one-class machine learning methods, analysis of non-linear features or similar damage detection algorithms.

Advantages

- Cameras are quick to set up and can measure a large structure compared to traditional wired accelerometers that are labor intensive to use
- Without the need for physical access to instrument a structure, cameras can more easily collect data from structures that might otherwise be difficult or time consuming to instrument
- Continuous monitoring of structures with cameras is tractable in the near future

Categories For This Invention:

Computer Sciences & Information Technology
Imaging (Computer Sciences & Information Technology)
Signal Processing

Intellectual Property:
Methods and devices for measuring object motion using camera images
Issued US Patent

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Publications:
Video Camera–Based Vibration Measurement for Civil Infrastructure Applications
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External Links:
Computer Graphics Group
http://graphics.csail.mit.edu/