橋梁および建築構造物のリアルタイム地震モニタリングシステム

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OBJECTIVE

The development of an automated structure monitoring system is currently highly promoted in Japan to enable early evaluation of bridge safety after earthquakes. This paper presents an automated real-time monitoring system that is able to identify seismic events and to detect anomalies in the structures after these events using wireless accelerometer networks.

SUMMARY

The system consists of several triaxle accelerometers at critical locations and one or several trigger nodes for seismic event real-time detection as in Fig. 1. Sensor nodes are communicated in a wireless network and driven by dry batteries. Email notification function is also included to notify the inspector about the seismic event detection. Measured acceleration is sent to the cloud server in order to give easy access to inspectors and to allow abnormal detection creating a real-time monitoring system. Natural frequencies, modal shapes, and geometry inclination are indicators for evaluating structures. A reduction in natural frequency, change in mode shape, or geometry may indicate an anomaly change in structure due to cracks, damage in structures.

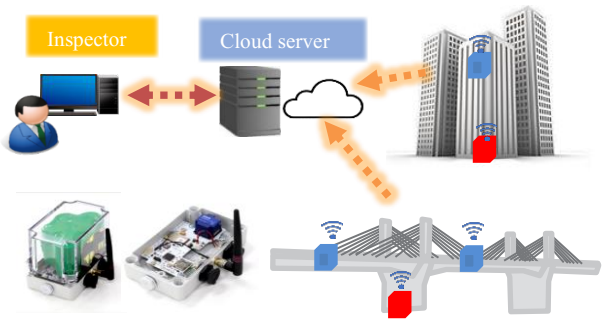

Fig. 1. Monitoring system structure

RESULTS

By tracking abnormal ground vibration using the trigger nodes, the seismic event can be detected in real-time. The intensity level of the seismic event is estimated real-time as well. Fig.2 shows the results of detected earthquakes at the monitored highway bridge.

Dynamic characteristic estimated by a scheduled measured data is used as a reference to detect anomalies. Whenever a seismic event would be detected, structural anomaly detection also would be implemented by comparing the statistic model of dynamic characteristics before and after the event. Fig. 3 shows a result of anomaly detection in frequency due to structural weight change in road construction work. The detection of such small changes confirmed the ability to detect slight damage or deterioration in structures.

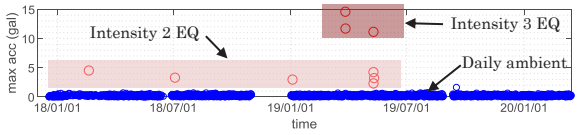

Fig. 2. Seismic event detection

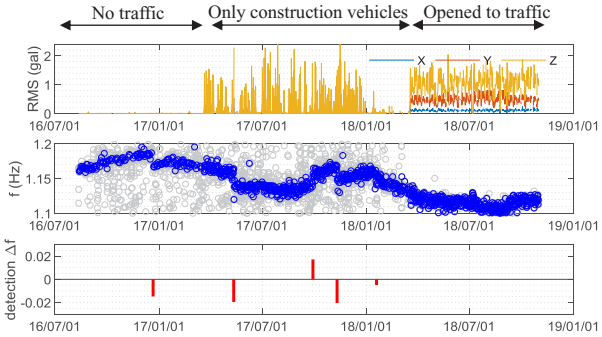

Fig. 3. Structural anomaly detection

Automated Real-time Seismic Monitoring System for Bridge and Building Structures

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Key Words : Monitoring, Damage detection, Inclination, Natural frequency, Ambient vibration