Form 2

Dissertation Abstract

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Dissertation title	Smart Device Based Autonomous and Low-Cost Structural Measurement and Monitoring System		

Abstract

※ The abstract should be in keeping with the structure of the dissertation (objective, statement of problem, investigation, conclusion) and should convey the substance of the dissertation.

Structural Vibration measurement of structures is one of the most essential issues in the field of Structural Health Monitoring as well as seismic disaster prevention. For this purpose economical, yet effective measurement methods are desirable to provide information on current state of structures by measuring the structural vibration, which is very rare. Using smart devices is one of the possible methods to measure structural vibration or ground motions. Smart devices, with their on-board computational and communication capabilities, offer new opportunities in the field of seismic and structural response measurement with extremely low initial and maintenance cost.

This study proposed methods for seismic and structural vibration measurement using such low cost smart devices. Two different approaches are considered for measurement purpose, the first is acceleration measurement method using built-in MEMS accelerometer and the other is displacement measurement method applying digital image processing techniques using built-in camera. Measurement application programs were developed for acceleration and displacement measuring, recording, data storage and cloud server synchronization. The reliability of proposed methods was evaluated by performing shaking table tests for both sine wave and scaled earthquake wave loading using different smart devices. Practical application of the proposed methods were also evaluated based on long-term on-site measurement. The advantages and limitations of the proposed method have been summarized.

Furthermore, in this study, for realizing end-to-end processing from raw observation data to analysis result, a novel method for auto classification of smart device recorded vibration signals has been proposed which can ultimately identify sensor induced faulty signals during long-term monitoring by using deep learning. By means of this, the bottlenecks of processing large amount of data is eliminated and dense observation of structural health conditions can be promoted. This method for auto classification of vibration records are performed in the smart device itself and in real-time by integrating deep learning models as a customizable and unique framework for classification purposes. The accuracy of the proposed method is cross-validated by utilizing the vibration data obtained from long-term monitoring. Besides, realizing smart devices as a low-cost system, a dense network of sensors can be established to collect large dataset and use it for damage identification using the same method in the future.