proceedings

Abstract

Recent Advances in Using Sensors for Structural Health Monitoring for Civil Structures †

Tommy H. T. Chan

School of Civil Engineering & Built Environment, Queensland University of Technology (QUT), QLD 4000 Brisbane, Queensland, Australia; tommy.chan@qut.edu.au

† Presented at the 5th International Symposium on Sensor Science (I3S 2017), Barcelona, Spain, 27–29 September 2017.

Published: 20 December 2017

Structural Health Monitoring (SHM) for civil structures involves the use of various sensing devices and ancillary systems to monitor the in situ behaviour of a structure to assess the performance of the structure and evaluate its condition. As SHM has demonstrated well its effectiveness in helping reduce operational costs and increase safety and reliability, it has attracted numerous researchers working in the area for the last three decades. SHM research can be divided into three main categories: (i) system development, (ii) sensors/measurement and (iii) applications. This presentation will report the recent advances in SHM in these three categories. In the first category, a number of test-beds have been selected covering a range of civil structural systems from laboratory models (two large-scale bridge models) and four real structures (i.e., a highway bridge, one 5-star-green rated medium-rise building, and two footbridges at QUT). In the sensors/measurement category, much of the recent work has been done to enhance the Fibre Bragg Grating (FBG) sensing technology. Recent developments include new FBG strain modulation methods and new FBG accelerometers using axial and/or transverse forces and vertical displacement measurements. The application category includes a number of ongoing projects on developing various Damage Detection (DD) methods, e.g., correlation Modal Strain Energies (MSE) with Multi-Layer Genetic Algorithm (ML-GA) based optimization; a multi-criteria approach using a combination of natural frequencies, Modal Frequencies (MF) and MSE to detect damage in bridges, buildings and dams; a correlation based method using the ratio of geometric MSE and natural frequency (GMSEF); time domain based methods based on Auto-Regressive (AR) and Auto-Regressive Moving Average (ARMA) models; enhanced MF for locating damage in suspension bridge main cables and hangers. Apart from DD topics, a group has been involved in developing methods to identify the effective prestress force in prestressed concrete box girder bridges by combining various Moving Load Identification (MLI) methods and Electromagnetic Ultrasonic Transducers. Besides, the use of SHM for asset management will also be discussed.