Characterization of Multiple Hazards to Civil Infrastructures Using Novel Modeling and Signal Processing Technologies

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ABSTRACT

Smart structural systems refer to structural systems integrated with sensing, data processing, control and energy dissipation devices. These systems are adaptive to the change in external operating conditions and their important applications can be found in natural hazard mitigation. The past decade has seen a growing use of smart structural technologies in civil engineering structures around the world. Currently, the research and development activities in the field of smart structures for civil infrastructures are focused on the structural health monitoring, local identification and damage prognosis. Further, structural control is the second field of application for smart structural technologies. Generally, modern structural health monitoring hardware systems consist of sensors, a data acquisition and processing block, a communication item and a main computer center. The integrated product is composed of the following three items: a distributed sensing system able to monitor the structural response, actuators able to modify structural properties, and control units able to realize a pre-designed strategy. Besides, smart structural technologies include not only the hardware devices but also the accompanying software tools, realizing smart strategies of structural monitoring and control. Signal processing and computation are crucial elements in the implementation and operation of any damage identification system. The generic system requires the availability of appropriate signal processing technology to extract features from different types of sensors and to translate this information into a diagnosis of location and severity of damage. A challenging problem in structural health monitoring and control is to determine the damage prognosis model. In this presentation the following research topics in relation to the development of smart structures are discussed: (a) development of smart sensing systems and smart control devices, (b) development of the methodology for the identification of complex input force directly from structural vibration measurement, (c) development of algorithms for detecting structural damage from stochastic response data, either fully or partially measured, and (d) development of damage detection techniques using data-driven subspace identification and finite element model updating. Examples using NCREE (Taiwan) shaking table tests to verify the developed algorithms and devices will be introduced.

Biography

Dr. Chin-Hsiung Loh is a professor in the Department of Civil Engineering at the National Taiwan University. He is also a distinguished professor at the National Taiwan University. He received his Ph.D. degree in Civil Engineering from the National Taiwan University, and he had been Research Associates at UC Berkeley and University of Illinois at Urbana. He had also been a visiting scholar at Stanford University and California Institute of Technology, respectively, and a visiting professor at the University of Michigan, recently. He was the Director of National Center for Research on Earthquake Engineering, Taiwan, during 1997-2003, and the Director of National Center for Disaster Reduction in 2003. He also served as a program director of earthquake hazard mitigation program of NSC during 2005-2008. Dr. Loh currently is on the board of editor of several international journals including: *Earthquake Engineering and Structural Dynamics, Structural Control and Health Monitoring, and Structures and Infrastructural Engineering*. His research interests include Structural System Identification, Structural Health Monitoring, Structural Control and Earthquake Engineering.