Department of Civil Engineering
The University of Hong Kong

Distinguished Public Lecture

Rapid Post-earthquake Inspection and Evaluation of Civil Infrastructure

Date: April 28, 2025 (Monday)

Time: 10:30 a.m. to 11:30 a.m.

Venue: CPD-LG.18, Centennial Campus,
The University of Hong Kong

Professor B.F. Spencer

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Abstract

In the aftermath of an earthquake, rapid structural inspection and evaluation are critical to ensure that the normal order of life, work, and production can be restored quickly. To date, initial assessments of structures are based on visual information collected manually by certified inspectors and are known to be time-consuming, dangerous, and subjective. Moreover, the number of inspectors in an earthquake affected region may be limited, further delaying efforts to conduct these initial inspections. This lecture presents two recently proposed approaches for automated rapid post-earthquake safety assessment. The first approach employs sparse acceleration measurements to define damage-sensitive features that can be used to infer the condition of buildings. A convolutional neural network is then employed to uncover the complex relationship between the damage-sensitive features and the building condition. The proposed framework is validated experimentally using a 1/3-scale 18-story experimental steel building tested on the shaking table at E-Defense in Japan, confirming the efficacy of the proposed approach for rapid post-earthquake safety evaluation for high-rise buildings. Subsequently, a comprehensive strategy for rapid post-earthquake inspection and evaluation using images collected by commercial unmanned aerial vehicles (UAVs) is presented. The proposed approach employs a graphics-based digital twin (GBDT), which is comprised of a finite element (FE) model and a photo-realistic computer graphics (CG) model. The approach is illustrated for a 45-story high-rise building in Guangzhou, China. These results will enable rapid evaluation of inspection strategies and efficient decision making in the aftermath of an earthquake.

About the Speaker

B.F. Spencer, Jr. received his Ph.D. in theoretical and applied mechanics from the University of Illinois at Urbana-Champaign in 1985. He worked on the faculty at the University of Notre Dame for 17 years before returning to the University of Illinois at Urbana-Champaign, where he currently holds the Nathan M. and Anne M. Newmark Endowed Chair in Civil Engineering and is the former Director of the Newmark Structural Engineering Laboratory. His research has been primarily in the areas of structural health monitoring, structural control, stochastic fatigue, stochastic computational mechanics, and machine learning, and computer vision. Dr. Spencer has directed more than $70M in funded research and published more than 700 technical papers/reports, including two books. He was the first to study and design magnetorheological (MR) fluid dampers for protection of structures against earthquakes and strong winds, overcoming the inherent limitations of existing passive energy dissipation systems, as well as power-dependent active control systems, which are in common use today. His research on structural health monitoring systems and smart wireless sensors integrates advanced computing tools with smart sensors, to provide a functional platform with self-interrogation capabilities. Dr. Spencer has received numerous awards, including the ASCE Outstanding Instructor Award, the ASCE Norman Medal, the ASCE Housner Structural Control and Monitoring Medal, the ASCE Newmark Medal, the Zhu Kezhen International Lectureship Award, the ANCRiSST Outstanding Senior Investigator Award, the Structural Health Monitoring Person of the Year Award, the J.M. Ko Medal of Advances in Structural Engineering, IASCM Takuji Kobori Prize, and the Raymond & Sidney Epstein Structural Engineering Faculty Award. Dr. Spencer is a Distinguished Member of ASCE, a Foreign Member of the Polish Academy of Sciences, a Foreign Member of the Engineering Academy of Japan, a Foreign Member of the Chinese Academy of Engineering, the North American Editor in Chief of Smart Structures and Systems, the Executive Managing Editor of the journal of Earthquake Engineering and Engineering Vibration,and the past president of the Asia-Pacific Network of Centers for Research in Smart Structures Technology.

An attendance of certificate will be issued to participants after the public lecture

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