



Northeastern

Department of Civil and Environmental Engineering Distinguished Seminar Series

Advances in Monitoring of Civil Infrastructure: from Research to Engineering Practice

B.F. Spencer, Jr., PhD

Nathan M. and Anne M. Newmark Endowed Chair of Civil Engineering

University of Illinois at Urbana-Champaign

Monday, November 13, 2017 12:00pm - 1:00pm

135 Shillman Hall

Abstract

The ability to continuously monitor the integrity of civil infrastructure in real time offers the opportunity to reduce maintenance and inspection costs, while providing for increased safety to the public. Furthermore, after natural disasters, it is imperative that emergency facilities and evacuation routes, including bridges and highways, be assessed for safety. Indeed, the ASCE Vision for Civil Engineering in 2025 states engineers of the future will be “relying on and leveraging real-time access to living databases, sensors, diagnostic tools, and other advanced technologies to ensure informed decisions are made.” This seminar discusses recent advances in monitoring of civil infrastructure at the University of Illinois at Urbana-Champaign. First, interdisciplinary efforts to create and deploy wireless smart sensors will be introduced. Following an overview of the technical challenges encountered and the solutions developed, two full-scale deployments will be presented. The first is for the Jindo Bridge, a cable-stayed bridge in South Korea with a 344m main span. The second deployment is for the Dubai-I, a 250-m diameter Ferris wheel. Subsequently, research on the use of computer vision for monitoring of civil infrastructure will be presented. Applications explored include crack detection in concrete structures, automatic structural damage classification, structural response monitoring, and motion magnification. Finally, the potential use of existing commercial UAVs and cameras to measure the displacement of the railroad bridges under in-service train loads is considered. These studies demonstrate the tremendous potential of structural health monitoring for managing civil infrastructure on a national level.

Biographical Sketch

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 Director of the Newmark Structural Engineering Laboratory. His research has been primarily in the areas of structural health monitoring, structural control, cyberinfrastructure applications, stochastic fatigue, stochastic computational mechanics and natural hazard mitigation. Dr. Spencer has directed more than \$50M 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. He led NSF's George E. Brown Network for Earthquake Engineering Simulation (NEES) system integration project, which constituted the nation's first engineering cyberinfrastructure initiative. He was the PI on the NEES MUST-SIM facility at the University of Illinois focusing on hybrid simulation. His most recent 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. He led the Jindo Bridge monitoring project in South Korea, which constitutes the world's largest deployment of wireless smart sensors to monitor civil infrastructure to date. Dr. Spencer has received numerous awards, including the ASCE Outstanding Instructor Award, ASCE Norman 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, the Raymond & Sidney Epstein Structural Engineering Faculty Award, and the ASCE Housner Structural Control and Monitoring Medal. Dr. Spencer is a Fellow of ASCE, a Foreign Member of the Polish Academy of Sciences, the North American Editor in Chief of Smart Structures and Systems, and the past president of the Asia-Pacific Network of Centers for Research in Smart Structures Technology.



Bill F. Spencer

Nathan M. and Anne M. Newmark Endowed Chair in Civil Engineering
Department of Civil and Environmental Engineering
UNIVERSITY OF ILLINOIS – URBANA CHAMPAIGN

Education

- **PhD Theoretical and Applied Mechanics, *UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN, 1985***
- **M.S. Theoretical and Applied Mechanics, *UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN, 1983***
- **B.S. Mechanical Engineering, *UNIVERSITY OF MISSOURI, 1981***

Research Interests

- **Structural Engineering**
- **Structural Health Monitoring**
- **Structural Control**
- **Societal Risk Management**
- **Stochastic Computational Mechanics**
- **Cyberinfrastructure Applications**

Selected Service and Awards

- **Director, Newmark Structural Engineering Laboratory**
- **Director, Multi-Axial Full-Scale Sub-Structured Testing & Simulation Facility**
- **Director, Smart Structures Technology Laboratory**
- **ASCE Housner Structural Control and Monitoring Medal 2015**