G-COE Special Seminar at Tokyo Institute of Technology
November 12th, 2009

Sensor and structural health assessment of structures using bond graphs

Abbas Moustafa

Visiting Assistant Professor (JSPS Fellow)
Department of Urban & Environmental Engineering
Kyoto University

This research develops a new and efficient hybrid qualitative–quantitative system identification methodology for structures using the bond graph approach. Bond graphs provide a modeling framework that includes parametric models of both the physical system and the sensors. Structural damage is modeled as reductions in the parameter values of the structural components. Sensor faults are modeled as biases or drifts from true responses. The damage detection uses a statistical method to identify significant deviations of measurements from nominal healthy behavior of the structure. Damage isolation is carried out by comparing the predicted signatures of various damage scenarios with the observed behavior of the structure. The damage signatures are derived off-line before sensor data collection. Quantitative identification of the damage amount uses the least-squares method, analyzing only the sub-structure containing the damaged component. Numerical illustrations of damage identification of frame structures driven by time-varying loads are provided, highlighting advantages with respect to sensor fault identification and computational efficiency.

References:

Moustafa, A, Daiglae, M, Mahadevan, S, and Biswas, G. (2007). Fault diagnosis of civil engineering structures using the bond graph approach. *18th International workshop on principles of diagnosis, May 29-31*, Nashville, TN, 146-153.

Moustafa, A, Daiglae, M, Mahadevan, S, and Biswas, G. (2008). Structural and sensor damage identification using the bond graph approach. *Structural Control & Health Monitoring*, in press (DOI: 10.1002/stc.285).

15:00 – 16:00, November 12, 2009 (Thursday)
CUEE conference room at Midorigaoka Building 3, Room 304

Dr. Moustafa received his B.Sc. (1992) and M.Sc. (1996) in Civil Engineering from Minia University, Egypt. He obtained his Ph.D. from the Indian Institute of Science, Bangalore in 2002. Dr. Moustafa has worked at Minia University, Egypt as a Demonstrator (1992-1996), Lecturer (1996-1997) and Assistant Professor (2002-date) in the Department of Civil Engineering. He has been also a visiting Faculty at Nagasaki University (Jul. 2004-Dec. 2005, Apr. 2008-Dec. 2008), Vanderbilt University (Jan. 2006-Feb. 2008) and Kyoto University (Jan. 2009-date). His research interests include earthquake engineering, nonlinear dynamics, random vibration, structural reliability and structural health monitoring. He has worked on developing a new health assessment framework for sensors and structural components using bond graphs (funded by US Air Force).

Please contact Assoc. Prof. Anil C. Wijeyewickrema (Ext. 2595) for more information.