Structural Engineering Seminar Series

CEE 595 S

In-test analytical model updating for accurate hybrid dynamic simulations

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Abstract:

Hybrid simulation is the most reliable assessment approaches for structural systems that have features exceeding laboratory capabilities. It combines the effectiveness of numerical modeling with the accuracy of experimental investigations by sub-dividing the structural system into a computer-simulated part and a physically tested part. The components that exhibit highly inelastic behavior are tested in the laboratory, while the rest of the structural system is numerically modelled. Many structural systems have two features that reduce the effectiveness, efficiency and/or accuracy of hybrid simulation. These are (1) if there are too many components that require physical testing at full scale, a challenge that few laboratories around the world have the capacity to address, or (2) the specific critical components that are likely to result in structural failure cannot be predicted, hence many components require the accuracy and realism of physical testing. The concept of in-test model updating in hybrid simulations addresses the two challenges. In this approach, only one component is experimentally investigated. During the test, experimental measurements are utilized to instantaneously and repeatedly update the governing parameters of the numerical model. The numerical model therefore exhibits increased accuracy with every time-step in the ongoing hybrid simulation. Practical examples from the NEES@Illinois research work and other researchers are presented to demonstrate the effectiveness, and challenges, of in-test model updating in hybrid simulation.

Bio:

Fellow of the British Royal Academy of Engineering Amr Elnashai is professor of Civil and Environmental Engineering at the University of Houston. He completed 5+ years as Vice Chancellor and Vice President for Research and Technology Transfer at the University of Houston System and the University of Houston, respectively. Prior to the University of Houston, he was Dean of Engineering at the Pennsylvania State University and the Harold and Inge Marcus Endowed Chair of Engineering. He was previously head of the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign (June 2009 to December 2013) and the Bill and Elaine Hall endowed professor. Before moving to the Illinois, Amr was division head of engineering seismology and earthquake engineering at Imperial College, London, and a chaired professor.

He obtained his Bachelor of Science degree from Cairo University followed by MSc and PhD degrees from Imperial College, University of London. Amr's research interests are multi-resolution distributed analytical simulations, network analysis under stress and disruption, large-scale fire ignition and spread modeling, hybrid testing, and field investigations of the response of complex networks and structures to earthquakes. His early research was on design and stability of offshore oil and gas production platforms. He has advised 47 PhD students and over 100 MS thesis students. He published 148 refereed journal papers, 3 books, 11 book chapters, and conference papers, research and field investigation reports.

Monday, March 6th, 2023 4:00 – 5:20 p.m.

1310 Yeh Student Center