Astani Department of Civil and Environmental Engineering Seminar

Tuesday, January 21, 2020
2:30pm – 3:30pm, KAP 209

Machine Learning Approaches in Modeling Complex Structural Problems

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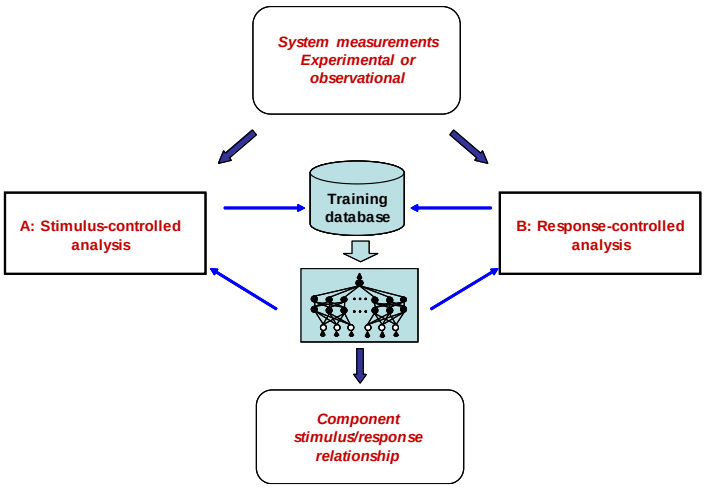
Abstract

The reliable performance assessment of complex structural systems under non-monotonic loading conditions remains a challenging problem especially when systems are exposed to severe stress. There have been major and impactful developments in both analytical and experimental investigation tools, as well as hybrid analytical-experimental approaches. Less has been accomplished in applications of machine learning to extract response patterns from large response data sets and use the ensuing knowledge-based models in structural assessment under severe loading scenarios.



In this presentation, the concept of data model development and implementation is discussed, followed by an account of relative merits and drawback. Formulations based on machine learning algorithms to represent constitute relationships for steel and use in FE analysis of buildings. Further refinement and extension of the approach is presented in terms of deriving a model for, for example, a complex steel beam-column connection based on data-modeling of the components and assembling this component-based data model. Finally, a hybrid informational-physical model of the beam-column connection is developed and shown to replicate the behavior almost exactly with successive training. Such approach is also shown to exhibit predictive characteristics, unlike the majority of data-trained models. The presentation concludes with thoughts on extending the hybrid approach to populations of buildings in impact assessments at a regional scale. The work presented is derived from the PhD thesis of JunHee Kim (currently professor at Yonsei University) supervised by Jamshid Ghaboussi and the presenter.

Short CV

Amr Elnashai
Email: Elnashai@uh.edu
Vice President/Vice Chancellor for Research and Technology Transfer
University of Houston/University of Houston System (since July 24, 2017)

Past Positions

- Harold and Inge Marcus Dean, College of Engineering, Penn State (2013-2017)
- Head of CEE, Emeritus Professor, University of Illinois, Urbana-Champaign (2000-2013)

CAREER SUMMARY

Fellow of the British Royal Academy of Engineering Amr Elnashai is Vice Chancellor and Vice President for Research and Technology Transfer at the University of Houston System and the University of Houston, respectively. He manages the research enterprise of the University of Houston and the University of Houston System, with an annual research expenditure of $195M, and an IP income of $43M. He is also in charge of the UH Technology Bridge. Prior to his current position, 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. He was Director of the NSF multi-institution interdisciplinary Engineering Research Center (ERC), MAE Center (2004-2009). He was also Director of the NSF Network for Earthquake Engineering Simulations (NEES) Laboratory at Illinois (2002-2009). His total research expenditure during his 13 years at Illinois was in excess of $20M.

Amr obtained his Bachelor of Science degree from Cairo University followed by MSc and PhD degrees from Imperial College, University of London. Before joining the University of Illinois in June 2001, Amr was Professor of Earthquake Engineering and Head of Division at Imperial College. He was Visiting Professor at the University of Surrey, UK. Other visiting professor appointments include the University of Tokyo, the University of Southern California, and the European School for Advanced Studies in Reduction of Seismic Risk, Italy.

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. He has advised 46 PhD students and over 100 MS thesis students. He published more than 140 refereed journal papers, 4 books and many other publications.