The Department of Civil and Environmental Engineering at the University of Houston presents...

CIVE 6111 Graduate Seminar

Advances in Real-time Cyber-Physical Simulation: Enhancement of Performance-Based Engineered Structural Systems for Multi-Natural Hazards

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Friday, February 17, 2023
2:45pm-3:45pm
Zoom: https://uh-edu-cougarnet.zoom.us/j/94589160391

Abstract

Stakeholders are demanding that the performance of the built civil infrastructure be more resilient to natural hazards in order to reduce their impact on society. Performance-based engineering is a means to attempt to meet performance objectives associated with prescribed levels of hazards. A viable technique to meet validation requirements for performance-engineered structural systems is to use real-time hybrid simulation to perform cyber-physical experiments. The complete system is involved in these simulations, where selected components of the system are modeled physically while others are numerically using computational models. The modeling of the former in the physical domain is required because accurate computational models do not exist for these components. In such studies the response modification devices can be coupled to a system and the system subjected to a prescribed hazard with a specific return period, enabling system performance under prescribed levels of realistic hazard demands to be investigated. The talk will present results from recent efforts that the presenter and his research team have completed to advance large-scale multi-directional real-time hybrid simulation. Topics of the talk include the development of model-based unconditionally stable dissipative explicit direct integration algorithms, explicit state-determination force-based fiber elements, and adaptive servo-hydraulic actuator control algorithms. The talk will conclude with applications of these developments to perform real-time hybrid simulations of nonlinear structural systems subjected to earthquake and wind hazards, including extensions to perform real-time aeroelastic hybrid simulations of a tall building.

Bio

James Ricles works in the area of structural engineering and mechanics as well as large-scale experimental simulations. His research includes the development and implementation of computational frameworks for large-scale multi-directional real-time hybrid simulations applied to complex structural systems. He is the principal investigator and director of the NSF Natural Hazards Engineering Research Infrastructure (NHERI) Experimental Facility located at Lehigh University. He is also a registered professional engineer in the State of California and serves on the Editorial Advisory Board for the International Journal of Earthquake Engineering and Structural Dynamics. James is the recipient of the NSF Presidential Young Investigators Award, the ASCE Raymond C. Reese Research Prize and AISC Special Achievement Award for his work in innovations in structural resiliency.