CONTINUOUS HYBRID SIMULATION WITH GEOGRAPHICALLY DISTRIBUTED SUBSTRUCTURES

Abstract: The hybrid simulation test method is a versatile technique for evaluating the seismic performance of structures by smoothly integrating physical and numerical simulations of substructures into a single model. This method has advanced considerably since its inception 25 years ago, moving from ramp-hold loading histories to more reliable continuous and real-time loading histories on the experimental specimens. The establishment of the George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES) provides for a further increase in the size and complexity of the models that can be tested using hybrid simulation, including the integration of advanced analytical modeling tools as well as the infrastructure for geographically distributed testing.

A control system will be presented that supports the implementation of computationally demanding hybrid simulation algorithms including: continuous algorithms, real-time algorithms, and hybrid testing with geographically distributed substructures. This controller is based on an event-driven scheme, as opposed to a real-time clock-based controller, to implement continuous algorithms on distributed models where network communication, numerical integration and other tasks may have random completion times. The advantage of the event-driven approach is that logic can be included to minimize, if not eliminate, the adverse effects of random completion times on the stability and accuracy of the test. This procedure is demonstrated by computing the earthquake response of a two story building model with two physical substructures located at remote sites connected using the TCP Internet Protocol. An evaluation of the hardware architecture for real-time applications is planned in the near future. Additionally, dynamic models of a test setup for hybrid testing, including reaction wall, specimen and actuators, will be presented. These models are useful in identifying limitations of the test equipment prior to attempting an expensive hybrid test, particularly when loading at real-time rates. Such simulations of simulations are needed for successful design and conduct of complex hybrid simulation experiments. A model for a typical hybrid test setup has been developed and can be calibrated based on results from a system identification of the actual experimental test setup.

The event-based hybrid test controller and dynamic models of the test setup are new tools in the portfolio of experimentalists. These analysis-based tools will help to deliver one promise of NEES: enable hybrid simulation at geographically distributed sites.

Short Biography: Mr. Mosqueda is a Ph.D. candidate at the University of California at Berkeley in the Department of Civil and Environmental Engineering. He completed a B.S. degree at the University of California at Irvine in 1993, a M.S. degree at the Massachusetts Institute of Technology in 1998 and will file his Ph.D. thesis in December 2003. His PhD research work at Berkeley has combined experimental and analytical studies including triaxial earthquake-simulator testing and numerical simulation of sliding and elastomeric bearings, and development of a hybrid simulation test method for use at the Berkeley node of NEES. His presentation will focus on the hybrid simulation test method.

DATE: MONDAY, OCTOBER 6th 2003
TIME: 2:30 – 4:30 PM (EST)
LOCATION: 414 BONNER HALL, NORTH CAMPUS, UB

FACULTY, GRADUATE STUDENTS & ALL OTHERS ARE INVITED TO ATTEND. For further information please contact Gordon Warn of the UB-EERI at (716) 645-2114 (ext.2437)

Refreshments will be served