Award Abstract #0121989

Large Scale Siesmic Performance of Urban Regions

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ABSTRACT

This award from the Engineering Research Centers Program is to connect the expertise in large-scale computational simulation and visualization at the Engineering Research Center on Computational Field Simulation at Mississippi State University, in geotechnical and structural response simulation at the Pacific Earthquake Engineering Research Center at the University of California, Berkeley, and in advanced computational ground motion and soil-foundation-structure-interaction modeling at Carnegie Mellon University to develop an advanced computational capability for modeling and visualizing the effects of earthquakes in urban regions on the built infrastructure, and to apply this capability to simulate the performance of collections of buildings and other structures in an urban region. The

ultimate goal is to forecast the amount and distribution of damage throughout an urban region. The proposed methodology will integrate "end-to-end" the earthquake source, path, basin, and surficial effects of the geological structure of the region on ground motion, with realistic models of buildings and bridges, including soil-foundation-structure-interaction effects, to develop a distributed, high resolution simulation capability. Key features of the proposed distributed high-performance computational simulation environment are the following: realistic representation of the structure type, geometry and properties; detailed modeling of the soil structure in the near region of the structure; use of real surface topology and sub-surface geotechnical properties; high resolution in the node density of the ground motion to capture the higher frequencies required for determining structural response; explicit consideration of soil-structure-foundation interaction effects; analysis of the simultaneous earthquake response of a portfolio of buildings to examine structure-to-structure interaction effects through the soil and the effects of the built environment on the free-field earthquake ground motion; automated data storage, access, and transport; visualization of complex and large datasets representing behavior of individual structures and aggregates; and integration of these components in a distributed computational environment. This project will use the simulation environment to investigate the effects of earthquakes in the Los Angeles urban region. This problem is of great importance to hazard mitigation and seismic risk reduction because assessing the ground motion to which structures will be exposed during their lifetimes, and predicting their response to this ground motion, including potential damage, is an essential step for the appropriate design and retrofit of earthquake-resistant built infrastructure. Performance-based earthquake engineering methodologies are motivated by the need for scientific and transparent methods to relate seismic hazard to structural performance and loss. Forecasting damage and loss can also be of great use for emergency planning and management purposes. Visualization of damage in an urban region can aid policy makers and stakeholders in making informed decisions on how to reduce earthquake losses. The proposed simulation environment will use the Globus toolkit for access to the computational grid, the deployment of which NSF plans to support as part of the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES). When developed, the simulation environment will be accessible to the earthquake engineering community through NEES.

BOOKS/ONE TIME PROCEEDING

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