Research Project Highlight

A Pacific Rim Forum on Regional-Scale Simulations of Earthquake Ground Motions and Infrastructure Response for PBEE of Transportation Systems

TSRP Topic – Methodology – M2

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Start-End Dates:
4/1/2020 - 4/1/2021

Abstract
Rapid advancements in high performance computing platforms and state-of-the-art computational ecosystems, coupled with new understanding of the physics of earthquake processes, are creating an ability to realistically simulate earthquake ground motions and associated infrastructure response at regional scale. A computational capability to augment sparse observational data and inform the site-dependent, spatial variation of future earthquake ground motions and the complex manner in which earthquake waveforms interact with major infrastructure systems can support major advances in performance-based design of distributed transportation systems. This timely workshop will bring together multidisciplinary experts from structural and geotechnical engineering, and the earth sciences, to share recent research and state-of-practice advancements and apprise both the research and practitioner communities of recent developments. An additional focus will include critical discussions on the opportunities and appropriate pathway to bring high performance simulations into broader research efforts and PBEE practice.

Deliverables
A two-day PEER workshop will be held in CY2020. The two-day workshop will include:
- Day 1 – Tutorial/learning sessions to provide practitioners, early career engineers and students with basic knowledge of current high-performance computing, computational ecosystems and multidisciplinary science and engineering simulation software and frameworks;
- Day 2 – A full day workshop with expert presentations on recent technical developments in regional-scale simulations, and multidisciplinary panel discussions on the appropriate pathway to implementation in PBEE practice.

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Following the successful format of previous PEER Pacific Rim Forums, both domestic and international participants working on advanced simulations will be invited to participate to provide for the broadest awareness of emerging capabilities. Based on presentations and panel discussions of the workshop, a PEER workshop report will be created to capture and summarize the major technical points presented, as well as collective thoughts on the appropriate pathways toward implementation of regional simulations in PBEE practice in order to identify key research needs.

Research Impact

The ability to realistically and accurately simulate the complex end-to-end phenomenon of earthquake processes would provide a transformational capability for the economical and safe design of transportation systems. Advanced simulations offer a pathway to evaluate phenomenon that cannot easily be experimentally observed at full-scale in the field, increasing the insight and understanding necessary to address key transportation system design issues. This workshop will provide an opportunity for PEER to engage and organize the broader PEER community in an area that is rapidly developing and evolving, with significant potential to have a positive and profound impact on performance-based earthquake engineering over the next decade.

Specific benefits of the workshop will include:

- Informing the broad earthquake engineering community on the rapid developments and emerging capabilities in regional-scale simulations and the workflow and methodologies for coupling geophysics and engineering simulation models;
- Deep-dive technical presentations on the most recent developments in regional-scale simulations as they pertain to engineering evaluations and PBEE (see e.g. Figure 1 and recent regional simulation model development for the San Francisco Bay Area);
- Identification of remaining consensus key knowledge or computational gaps that should be addressed with priority in order for regional-scale simulations to be fully integrated into PBEE of transportation systems;
- Generate discussion and follow-on interest in PEER's research road-mapping activities to define the appropriate path for development of advanced, regional-scale simulations in PBEE practice for transportation as well as other distributed infrastructure systems.

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Project Image

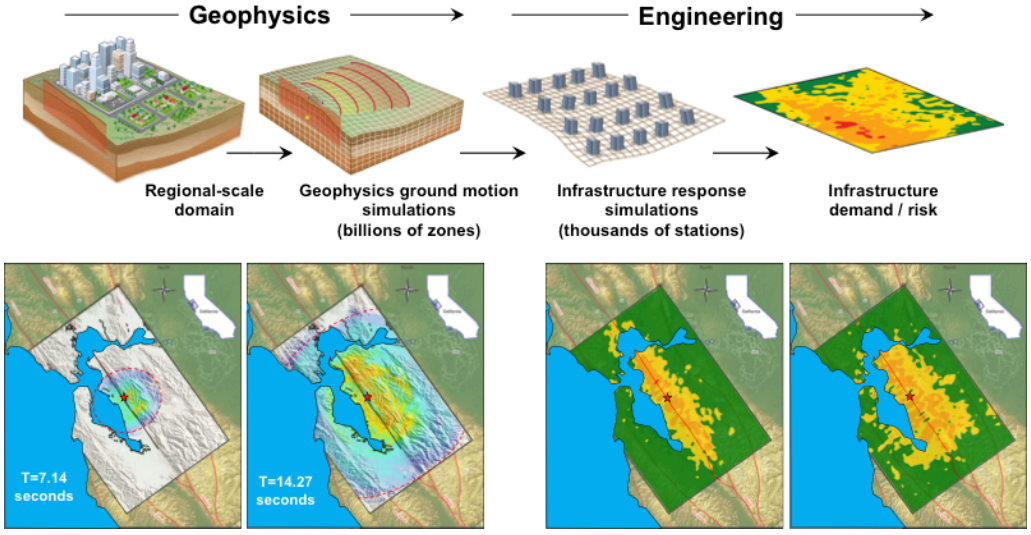

Figure 1. Regional-scale, fault-to-structure simulations with the U.S. Department of Energy supported EarthQuake Simulation (EQSIM) framework.

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