University at Buffalo
Department of Civil, Structural and Environmental Engineering
School of Engineering and Applied Sciences

ENGINEERING SEMINAR

Uncertainty Quantification in Earthquake Engineering through Stochastic Inverse and Forward Simulations

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Abstract

Presence of inevitable uncertainties and the need to explicitly account for them in predictions of the behaviors of structures during future seismic events have long been recognized by the earthquake engineering community. Pioneering work by the Pacific Earthquake Engineering Research (PEER) Center during the early 2000s saw the development of the performance-based design framework to account for those uncertainties in the design philosophy. However, numerical simulations of the behavior of solids and structures under seismic loading – which are increasingly being used to feed the performance-based design framework – still remain largely deterministic, amid the presence of large uncertainties in the systems. This is mainly due to the issue of limited available data (measurements) to characterize the uncertainties in the model parameters and due to the computational tractability of the Monte Carlo approach in probabilistically solving the governing equations of solid mechanics with uncertain material parameters and uncertain forcing function.

This seminar will discuss recent developments of computationally efficient numerical algorithms for quantification of uncertainties in model parameters in the presence of limited data and subsequent probabilistic predictions of the behavior of solids and structures during future seismic events. The algorithms will be illustrated through spatial and statistical characterization of the shear modulus of soil at a fictitious site using limited geophysical measurements and through probabilistic prediction of the behavior of a soil-foundation-structure system during a future seismic event considering uncertainties in both soil and structural material parameters as well as in the bedrock motion. Finally, through a detailed parametric study by varying the input uncertainty parameters, the shortcomings of the conventional deterministic analysis approaches will be highlighted.

Date: Friday, November 17th, 2017 Time: 11.00 am
Location: 140 Ketter Hall, North Campus, University at Buffalo