Course Description
In simulations of complex physical systems, uncertainties arise from imperfections in the mathematical models introduced to represent the systems and their interactions with the environment. Such uncertainties lead to significant uncertainties in the predictions using simulations. Since such predictions form the basis for making decisions, the knowledge of these uncertainties is very important. The course will present the Bayesian framework, the associated computational tools, selected applications, along with the main challenges for quantifying and propagating uncertainties in complex structural dynamic simulations.

Course Outline
Bayesian uncertainty quantification and propagation in structural dynamics simulations
- Bayesian model parameter estimation / model updating
- Bayesian model class selection
- Updating robust predictions and robust reliability
- Structural health monitoring using Bayesian model selection and updating

Bayesian computational tools
- Asymptotic approximations
- Sampling techniques

Case studies
- Full-scale seven-story shear wall building tested on shake table
- Dowling Hall Footbridge
- Metsovo Bridge
- Small-scale laboratory vehicle model with nonlinear suspensions

High performance computing for Bayesian UQ of complex models
- Component mode synthesis
- Surrogate techniques (kriging, polynomial chaos)
- Parallel computing
- Demonstration on high fidelity linear/nonlinear bridge models

Optimal experimental design
- Information entropy
- Optimal sensor placement
- Optimal excitation characteristics

Who Should Attend
Engineers, researchers and graduate students who deal with finite element model validation as well as uncertainty quantification and propagation in structural dynamics simulations using vibration measurements.

Course Fee
The regular course fee for Bayesian Uncertainty Quantification: Theory, Computational Tools, and Applications is $400, and the student course fee is $200. Course fee includes lunch, course handout material, and refreshment breaks. Lodging and additional food or materials are not included.

Instructors
Professor Costas Papadimitriou—University of Thessaly, Greece
Papadimitriou (PhD CalTech) is Professor of Structural Dynamics at the University of Thessaly (Greece). He holds the position of the Executive Vice-President of the European Association of Structural Dynamics (EASD). He has over 25 years of experience in the areas of Bayesian uncertainty quantification and propagation, computational structural dynamics, finite element model validation, structural health monitoring and structural reliability. He has co-authored over 180 papers in journals and conference proceedings and co-edited two special journal issues on the subject and the section on Structural Health Monitoring in the Encyclopedia of Earthquake Engineering. He has organized more than twenty minisymposia on the subject and has given invited/keynote lectures in international conferences. He chairs the “Dynamics” committee of ASCE-EMI and the “Identification, Model Updating and Inverse Problems” committee of EASD.

Professor Babak Moaveni—Tufts University
Dr. Moaveni is currently an Assistant Professor at the Department of Civil and Environmental Engineering at Tufts University. He obtained his Ph.D. in structural Engineering at University of California, San Diego in 2007. Dr. Moaveni’s main research interests include vibration-based damage identification and structural health monitoring of real-world structures; dynamic field testing; finite element model updating; and uncertainty quantification in structural dynamics.

Held in conjunction with IMAC-XXXIII organized by the Society for Experimental Mechanics, Inc. More information can be found at http://sem.org