"Uncertainty Quantification in Multiscale Deformation Processes"

Thursday, January 19, 3:00 p.m.

Room 823 Benedum Hall

Abstract: We will introduce and discuss several problems relevant to predictive multiscale deformation processes. Starting with a material point, we will address methods for quantifying uncertainty in polycrystal microstructures and computing the probability distribution of the observed macroscale properties. We will emphasize mechanical properties including fatigue indicator parameters for superalloys. The mechanical response and properties of a deformed workpiece are sensitive to the initial microstructure associated with each macropoint. Microstructures are random in nature and location-specific. This location-dependence dramatically increases the dimensionality of the stochastic input (curse of dimensionality). To quantify and capture the propagation of uncertainty in multiscale deformation processes, a data-driven bi-orthogonal decomposition strategy is introduced. The multiscale random field representing the random microstructure is decomposed into a few modes in different (macro and meso) scales, simultaneously. As a result, the stochastic input complexity is remarkably simplified. An example of a multiscale forging problem is provided to show the merit of this methodology and to study the effects of uncertain initial grain size distribution and texture on the macroscopic properties. In closing, we will briefly introduce a number of upcoming directions in predictive materials modeling including graph-theoretic approaches.
**BIO:** After completing doctoral work in Theoretical and Applied Mechanics, Professor Zabaras joined the faculty of the Mechanical Engineering Department at the University of Minnesota, Minneapolis, MN. He became a Cornell faculty member in 1991. Zabaras is a Fellow of the American Society of Mechanical Engineers, and member of the American Physical Society, the American Academy of Mechanics, the Society for Industrial and Applied Mathematics and the Minerals, Metals & Materials Society. He received a Presidential Young Investigator Award from the National Science Foundation in 1991.

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**Events**

**January 12, 2012**

"ENHANCING STOCHASTIC KRIGING METAMODELS FOR COMPUTER SIMULATION"

Xi Chen, Department of Industrial Engineering and Management Sciences

Northwestern University

3:30 p.m. G31 Benedum Hall [(Learn More)]

**January 19, 2012**

"UNCERTAINTY QUANTIFICATION IN MULTISCALE DEFORMATION PROCESSES"

Dr. Nicholas Zabaras, Materials Process Design and Control Laboratory, Sibley School of Mechanical and Aerospace Engineering

Cornell University

3:00 p.m. 832 Benedum Hall [(Learn More)]

**Fall Term 2011**

ADV Topics in Operations Research: Conic Programming [(Learn More)]

Integer Programming Course [(Learn More)]
November 3, 2011

"UNCERTAINTY QUANTIFICATION IN SIMULATION OF MICROSYSTEMS"

Dr. Nicholas Zabaras, Dr. Jayathi Y. Murthy, Professor of Mechanical Engineering and Director PRISM: NNSA Center for Prediction of Reliability, Integrity and Survivability of Microsystems, Purdue University

3:00–4:00 P.M. Room 823 Benedum Hall (Learn More)

November 10, 2011

"MULTISCALE SIMULATION OF LIQUIDS UNDER CONFINEMENT"

Dr. Narayan Aluru, University of Illinois, Urbana-Champaign, Beckman Institute for Advanced Science and Technology – Department of Mechanical Science and Engineering

3:00–4:00 P.M. Room 823 Benedum Hall

(Learn More)

November 11, 2011 "FROM SORCERY TO SCIENCE: HOW HOLLYWOOD PHYSICS IMPACTS SCIENCE"

Dr. Eitan Grinspun, Department of Computer Science, Columbia University

3:30 - 4:30 PM

CARNEGIE MELLON UNIVERSITY, ROOM: NSH 1305 (Learn More)