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SEMINAR

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304 Whitehead Hall  
Refreshments: 3:30 p.m.  
Seminar: 4:00 p.m.

**SIMULATION AND CHARACTERIZATION OF COMPOSITE MATERIALS  
WITH RANDOM MICROSTRUCTURE**

ABSTRACT

Material properties in many engineering analyses are generally represented by average, or homogenized, values for calculating macroscopic behavior, a practice that ignores the micro-scale fluctuations in real materials. This assumption of homogenized material properties is based on the existence of a representative volume element (RVE), which is generally valid when considering displacements, average strains, and average stresses of structures where the loading and boundary conditions are at a much larger scale than the microstructure. The RVE assumption is less valid, however, for some of the recently emerging applications of composites to very small-scale systems (e.g., MEMs or thin-film coatings). Further, even for large-scale systems, the homogenized assumption does not yield an accurate measure of local stresses that are often linked to critical structural behavior. This presentation will first describe some recently developed techniques for simulating multi-phase material microstructures, which can be treated as discontinuous stochastic processes. Such simulations will allow serial generation of material microstructures that may be applied to numerical models of the mechanical behavior, such as finite elements. The second part of the presentation will provide a moving-window basis for estimating local mechanical properties and stresses in random composites and functionally graded materials. Through stochastic simulation, the variability in the local stresses is assessed as a means of evaluating the severity of inherent randomness in composite materials.