AEROSPACE & MECHANICAL ENGINEERING

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INFORMAL COFFEE PERIOD BEFORE THE SEMINAR IN ROOM 365 FITZPATRICK HALL

UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: **Professor Martin Ostoja-Starzewski**
Department of Mechanical Science and Engineering
Institute for Condensed Matter Theory, and Beckman Institute
University of Illinois at Urbana-Champaign
Urbana, Illinois

TOPIC: **RANDOMNESS AND FRACTALS IN MECHANICS OF MATERIALS**

DATE: Tuesday, August 30, 2011

TIME: 3:30 p.m.

PLACE: 138 DeBartolo Hall

ABSTRACT

Microstructural randomness is present in just about all solid materials. When dominant (macroscopic) length scales are large relative to microscale ones, we can safely work within classical, deterministic solid mechanics. However, when the separation of scales does not hold (e.g. in composite, polycrystalline, geological, biological materials) various concepts of continuum solid mechanics need to be re-examined and new methods developed. In this talk we focus on scaling from a Statistical Volume Element (SVE) to a Representative Volume Element (RVE). Using micromechanics, the RVE is set up in terms of two hierarchies of bounds stemming, respectively, from Dirichlet and Neumann boundary value problems set up on the SVE. We discuss the trends to approach the RVE in planar conductivity, linear/nonlinear (thermo)elasticity, plasticity, and Darcy permeability. This methodology then forms a logical basis for setting up of continuum random fields and stochastic finite element methods.

The above approach also allows one to ask the question: Why are fractal patterns observed in inelastic materials? We address this issue in the setting of 2D or 3D elastic-plastic materials, whose grain-level properties are random fields of white-noise type (i.e. lacking any spatial correlation structure). We find that fractal patterns of plasticized grains gradually form in the material domain and the sharp kink in the stress-strain curve is replaced by a smooth change. This is universally the case for a wide range of different elastic-plastic materials of metal and soil type, made of isotropic or anisotropic grains, possibly with thermal stress effects.

NOTE: ***If you are interested in meeting individually with Prof. Ostoja-Starzewski, please contact Evelyn at 631-5431***