NGSEA SEMINAR SERIES

Friday, Dec. 4th, 12:00 - 1:00 PM Shillman 215

Topics in Material Micromechanics: Cellular Metals and Stochastic Homogenization

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ABSTRACT

Using steel as a base material for engineered cellular materials is a relatively new capability and there are several versions of steel foam that can be produced at the laboratory scale. During the course of an NSF-funded project a hollow sphere steel foam produced by the Fraunhofer Institute in Germany was characterized in terms of mechanical properties and microstructure. Those characterizations are described along with constitutive models appropriate for the unique deformation characteristics of foams and example structural application of such foams.

All materials exhibit heterogeneity of material properties when examined at sufficiently small length scales and it is common in engineering analysis to average or homogenize those spatially varying properties to determine a single, spatially invariant, set of material properties. What is usually neglected, however, is that unless the domain over which the averaging is occurring is a representative volume element, the spatially invariant set of material properties is itself random. For example, if one averages a spatially varying elastic modulus over a problem domain, the resulting average is a random variable. New techniques are presented for estimating the variance of the homogenized material properties without the need for computationally expensive Monte Carlo simulation or approximations that assume small amplitude random fluctuations. Potential applications of this stochastic homogenization scheme to multi-scale analysis are presented.

BIO

Prof. Arwade has studied structural engineering and mechanics at Princeton University (B.S.E.) and Cornell University (M.S. and Ph.D.). He has been on the faculty of civil engineering at Johns Hopkins and the University of Massachusetts, Amherst. His research into stochastic material mechanics and structural reliability has been funded by the National Science Foundation, industry and state groups.

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