University at Buffalo
Department of Civil, Structural and Environmental Engineering
School of Engineering and Applied Sciences

ENGINEERING SEMINAR

Microstructure probabilistic models and estimates of extreme material responses

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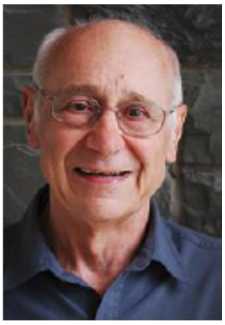
Abstract

The presentation has two parts. The first part develops models for the compliance tensor A(x), x ∈ D, of linear elastic random materials, where D denotes a specimen domain. The models are matrix-valued random fields which are symmetric and positive definite at each x ∈ D. Their construction uses the fact that the samples of the real-valued random fields {Λk(x), x ∈ D} defining the eigenvalues of {A(x), x ∈ D} must be positive in D. Numerical examples are used to illustrate the implementation of the proposed models. The second part develops estimates for the distribution of extreme material responses. A thin rectangular plate with random compliance A(x) stretched uniformly in the long direction is used for illustration. Let {Σ(x), x ∈ D} denote the stress tensor in the plate. Samples of this field are obtained from independent samples of A(x) as solutions of deterministic elasticity problems. Numerical results are presented for pf (σ) = P (supx∈D{Σ1(x)} > σ), where Σ1(x) denotes the largest principal stress at x ∈ D. Monte Carlo estimates of small probabilities pf (σ) are not feasible in realistic applications. We propose an alternative method which constructs estimates of pf (σ) from a relatively small number of response samples by using concepts of extreme value theory (EVT). It is shown that the EVT estimates are stable, accurate, and extrapolate the empirical estimates of this probability beyond data.

About the Speaker



Professor Grigoriu has received a doctoral degree in civil engineering from MIT followed by degree in civil engineering and mathematics from the Institute of Civil Engineering and the University of Bucharest, Romania. His research interests are in random vibration, stochastic calculus, numerical methods for solving stochastic problems, probabilistic models for microstructures, wind/earthquake engineering, climate models, and Monte Carlo simulation. He is the author of over 200 papers in referred journals and four books on Random Vibration of Mechanical and Structural Systems (with T.T. Soong), Prentice Hall, 1992, Applied Non–Gaussian Processes, Prentice Hall, 1995, Stochastic Calculus, Applications in Science and Engineering, Birkhüaser, 2002, and Stochastic Systems. Uncertainty Quantification and Propagation, Springer, 2012. Professor Grigoriu's research and education efforts have been recognized by the 1993 IASSAR Research Prize, the 1998 SAE Distinguished Probabilistic Methods Education Award, the election to the Romanian Academy of Technical Sciences (2004), the 2002 Alfred Freudenthal Medal, Daniel M. Lazar '29 Excellence in Teaching Award (2003), Doctor Honoris Causa from the Technical University of Civil Engineering, Bucharest, Romania(2004), Honorary member, Romanian Academy of Technical Sciences since 2000, the 2005 Norman Medal of ASCE., the grade of EMI Fellow, 2014, and the 2015 Newmark Medal. Professor Grigoriu is on the editorial board of numerous technical journals.

Date: Friday, October 28 Time: 11:00 a.m. to 12:00 p.m.
Location: 140 Ketter Hall, North Campus, University at Buffalo