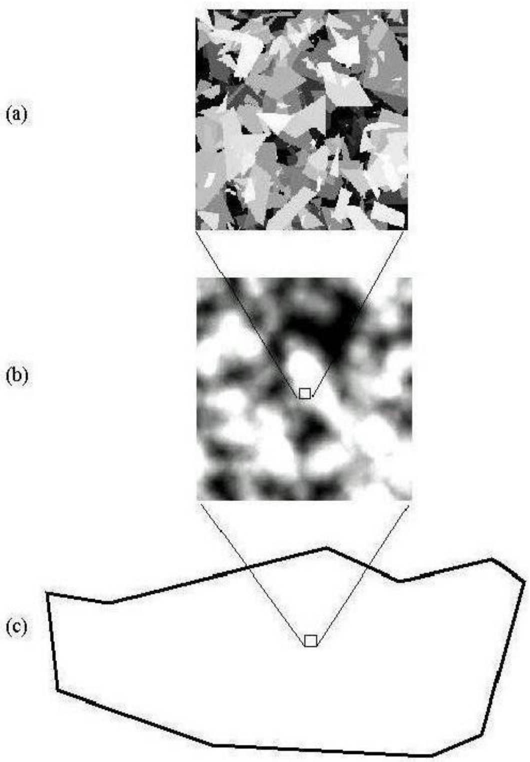
MECHANICS OF RANDOM MEDIA

MARTIN OSTOJA-STARZEWSKI
Department of Mechanical Science & Engineering
and Institute for Condensed Matter Theory
University of Illinois at Urbana-Champaign
http://martinos.mechanical.illinois.edu/



Key Questions:

Q1: How can we model random media?
Q2: How do we determine the effective response [of the Representative Volume Element (RVE)] in the function of some mesoscale relative to the microscale d (such as the grain size)?
Q3: What tensor random fields are admissible by the laws of mechanics?
Q4: How should the continuum random field in Fig. (b) be defined?
Q5: What universal statements can be made about the scaling of the Statistical Volume Element (SVE) domains, such as the one in Fig. (b), to the RVE?
Q6: How to solve general boundary value problems of random fields of elastic and inelastic properties?
Q7: How can we analyze wave dynamics in random elastic and/or inelastic media?
Q8: How to deal with fractal and Hurst effects in random processes and fields?

(a) A Boolean model of a microstructure; (b) a mesoscale continuum model obtained by placing, at every location, a mesoscale window in the microstructure of (a); (c) a macroscopic body.

Course Outline

1. Introduction to stochastic geometric models of microstructures
2. Scalar and tensor random fields; fractal and Hurst effects
3. Mesoscale bounds on effective responses of random elastic materials; size of representative volume element (RVE)
4. Mesoscale bounds for random nonlinear (in)elastic media; coupled fields, permeability
5. Stochastic mechanics as a basis for stochastic finite elements (SFE)
6. Oscillators, rods, beams with random/fractal properties under random/fractal loadings
7. Waves in random media

References (not required)

M. Ostoja-Starzewski (2008), *Microstructural Randomness and Scaling in Mechanics of Materials*, Chapman & Hall/CRC Press.

D. Jeulin and M. Ostoja-Starzewski (Eds.), *Mechanics of Random and Multiscale Microstructures*, CISM Courses and Lectures **430**, Springer, Wien, 2001.