

A data driven approach for generating reduced-order stochastic models of random heterogeneous media¹

Nicholas Zabaras and Baskar Ganapathysubramanian
Materials Process Design and Control Laboratory
Frank H T Rhodes Hall
Cornell University
Ithaca, NY 14853-3801

Stochastic analysis of random heterogeneous media provides information of significance only if realistic input models of the property variations are used. We will review a framework for constructing such input stochastic models using a data-driven strategy. This problem is analogous to the problem of manifold learning encountered in image processing and psychology. We showcase the methodology by constructing low-dimensional input stochastic models to represent property variations in two-phase and polycrystalline 3D microstructures. We will show how this model is used to model physical processes on the random microstructure. This framework has direct applicability to problems where working in high-dimensional spaces is computationally intractable, for instance, in visualization of property evolution, extracting process-property maps in low-dimensional spaces, among others. Furthermore, the generation of a low-dimensional surrogate space has major ramifications in the optimization of properties-processes and structures, making complicated operations like searching, contouring and sorting computationally feasible.

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