Stochastic modeling for statistical inverse identification in mechanics of materials

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ABSTRACT

Structural Health Monitoring of complex structures has gained a large interest from both the academic and industrial communities. In this context, current damage states are typically inferred from a comparison, for some quantities of interest, between healthy materials/structures and damaged ones. When applied to highly heterogeneous materials and/or to the detection of small-scale features, such approaches cannot readily accomodate the inherent variability that is exhibited by mesoscale responses, unless both the model and identification procedure are endowed with probabilistic and statistical ingredients.

In this talk, we provide a self-contained theoretical and algorithmic treatment of information-theoretic probabilistic models for modeling physical properties at some scale of interest; see [1, 2, 4, 5] for modeling aspects, and [6] for a discussion about sampling schemes. Such models were recently proposed and promoted as complements or substitutes to polynomial chaos representations [3, 7], especially when underdetermined statistical inverse problems are involved [3] over multiple scales. One application of industrial interest is the identification of random field representations for *in situ* damage prognosis of composite structures and polycrystalline materials. As an illustration of the aforementioned models and numerical schemes, we finally present the multiscale analysis of a polymer-based nanocomposite system, described at the atomistic level, for which a stochastic continuum representation of the interphase region is sought [8].

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