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Estimates of microscale features from macroscale measurements

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Surrogates based on polynomial chaos, collocation, and reduced order models have been used successfully to solve a broad range of forward stochastic problems. These methods have been extended to solve stochastic inverse problem. Generally, the Bayesian framework is used for solution, the operator defining the input/output relation is deterministic, measurements are polluted by random noise, and source parameters are unknown. We focus on inverse problems in which the operator is stochastic and partially known since, e.g., the random fields characterizing a material microstructure are known up to some parameters. Moreover, some of the unknown parameters of the random fields in the definition of these operators are not observable. Our objective is to identify the unobservable microscale parameters from macroscale measurements. We illustrate the approach by a simple one-dimensional stochastic transport equation in which the conductivity random field is known up to its spatial correlation and more realistic examples dealing with microstructures and polycrystals.

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