Statistical inverse method for the multiscale identification of the apparent random elasticity field of heterogeneous microstructures

C. Soize, C. Desceliers, J. Guilleminot, M. T. Nguyen
Université Paris-Est, Laboratoire Modélisation et Simulation Multi-Echelle (MSME, UMR CNRS)

and

J. M. Allain, H. Gharbi
Ecole Polytechnique, Laboratoire de Mécanique des Solides (LMS, UMR CNRS)

The presentation is devoted to a multiscale statistical inverse problem related to materials for which the elastic heterogeneous microstructure cannot be described in terms of constituents (for instance, a biological tissue such as the cortical bone). The objective is to identify the tensor-valued elasticity random field, (apparent elasticity field) at mesoscale, using multiscale experimental data. After introducing the difficulties induced by such a problem, the multiscale identification method is presented in two steps. The first one is devoted to the mathematical construction of an advanced prior stochastic model of the apparent elasticity random field at mesoscale, introducing a family of prior stochastic models for the non-Gaussian tensor-valued random field at mesoscale, and its generator. The second one deals with the multiscale identification of the prior stochastic model using a multiscale experimental digital image correlation, at macroscale and at mesoscale. The statistical inverse problem is then formulated as a multi-objective optimization problem. Finally, an application of the method is presented for multiscale experimental measurements of cortical bone in 2D plane stresses.