Stochastic Analysis of Mesoscopic Elasticity Random Rields obtained by Filtering Framework

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Abstract: Periodic homogenization of random heterogeneous materials generally requires the description of a complex, underlying random microstructure. In this context, Bignonnet *et al.* recently proposed a framework where smooth mesoscopic elasticity random fields are defined through a filtering procedure [1], hence allowing for the use of coarser discretizations in numerical homogenization methods. Interestingly, the above random fields have the remarkable consistency property to yield the same effective moduli at macroscale, regardless of the filtering resolution.

The present work is devoted to the construction, calibration and validation of a *prior* elasticity random field representation for a model microstructure. For illustration purposes, the latter is made up of an elastic matrix reinforced by bi-disperse spherical stiff heterogeneities. On the basis of a statistical characterization, we first introduce an information-theoretic model adapted from [2]. Next, the calibration task is performed by using either statistical estimators or the maximum likelihood principle. Both approaches are compared in terms of convergence and computational cost. Finally, the validation of the model is discussed by comparing experimental and simulated quantities of interest, such as the induced mesoscale stress field or the macroscopic homogenized properties.

Keywords: numerical homogenization, mesoscopic random field, material symmetry, maximum entropy principle, probabilistic model

References

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