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POD-DEIM model reduction for SFEM based computational homogenization

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In this work we perform stochastic homogenization of nonlinear-elastic heterogeneous materials. Due to the geometric uncertainties in the microstructure, the Stochastic FEM based framework is applied [1,2]. Thereby the SFEM discretization typically requires a huge number of nodal degrees of freedom and results in a large size of the stiffness matrix. In the current work we examine the application of POD based model reduction to the stochastic problem. Thus simultaneous reduction in stochastic and physical dimensions is performed. DEIM technique is used to reduce the integration domain. Thus the stiffness matrix and the residual vector of the reduced model are evaluated based on the response of only a few elements. Finally the proposed method is applied to the computational homogenization of heterogeneous materials with aleatoric uncertainty in the geometry of the microstructure.

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