Multilevel Monte Carlo Methods for Boundary Value Problems with Gaussian Parameters

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Multilevel Monte Carlo methods emerged recently as highly efficient solvers for a large variety of stochastic equations. We consider an elliptic boundary value problem depending on a matrix-valued log-Gaussian field, and show how the multilevel Monte Carlo approach is able to combine the truncation of a series representation of this random field, a finite element approximation and Monte Carlo sampling to solve this stochastic problem in essentially the same complexity as a single deterministic problem. Despite its simplicity, arguably due to its simplicity, this method has a wide range of applicability with respect to both the type of partial differential equation and the randomness in the equation.