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Solving the Stochastic Steady-State Diffusion Problem using Multigrid

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We study multigrid for solving the stochastic steady-state diffusion problem. We operate under the mild assumption that the diffusion coefficient takes the form of a finite Karhunen-Loéve expansion. The problem is discretized using a finite element methodology using the polynomial chaos method to discretize the stochastic part of the problem. We apply a multigrid algorithm to the stochastic problem in which the spatial discretization is varied from grid to grid while the stochastic discretization is held constant. We then show, theoretically and experimentally, that the convergence rate is independent of the spatial discretization, as in the deterministic case.