

Error estimation and adaptivity for stochastic collocation finite elements

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Abstract

Partial differential equations (PDEs) with uncertain inputs have provided engineers and scientists with enhanced fidelity in the modelling of real-life phenomena, especially within the last decade. Sparse grid stochastic collocation representations of parametric uncertainty, in combination with finite element discretization of physical space, have emerged as an efficient alternative to Monte-Carlo strategies over this period, especially in the context of nonlinear PDE models or linear PDE problems that are nonlinear in the parameterization of the uncertainty.

A multilevel adaptive refinement strategy for solving linear elliptic partial differential equations with random data is developed in this talk. The strategy extends the a posteriori error estimation framework introduced by Guignard & Nobile in 2018 to cover problems with a nonaffine parametric coefficient dependence. A suboptimal, but nonetheless reliable and convenient implementation of the strategy involves approximation of the decoupled PDE problems with a common finite element approximation space. Results obtained using a potentially more efficient multilevel approximation strategy, where meshes are individually tailored, will also be discussed in detail.

This is joint work with Alex Bespalov (University of Birmingham, UK) and Feng Xu.

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