CONVERGENCE OF ADAPTIVE STOCHASTIC COLLOCATION WITH FINITE ELEMENTS

ANDREA SCAGLIONI*, MICHAEL FEISCHL

ABSTRACT

Partial differential equations with random data are an increasingly popular modelling tool. Their numerical approximation is challenging from both the computational and theoretical points of view. In [1], we approximate a model PDE problem with random data using sparse grid (a collocation method) in the probability space and finite elements in the spatial domain. Both methods are adaptive: The set of collocation points used in the probability space is enlarged and the finite element meshes are refined. The adaptive refinement is steered by the reliable a-posteriori error estimator proposed in [2]. Our main result is a convergence proof of the adaptive algorithm. The analysis consists of two steps: First, we establish convergence of the semi-discrete (probability space only) scheme. Then, we extend the result to the fully discrete setting employing convergence properties of h-adaptive finite elements. To our knowledge, this is the first convergence proof of an adaptive stochastic collocation-finite elements scheme. Furthermore, we present numerical tests to validate the theoretical results and discuss the performance of the algorithm.

References

[1] M. Feischl, and A. Scaglioni, *Convergence of adaptive stochastic collocation with finite elements*,Computers & Mathematics with Applications. 98 (2021), 139–156.

[2] D. Guignard, and F. Nobile, *A posteriori error estimation for the stochastic collocation finite element method*, SIAM J. Numer. Anal. 56(5) (2018), 3121–3143.

* Institute of Analysis and Scientific Computing, TU Wien, Austria, andrea.scaglioni@tuwien.ac.at