VERIFICATION AND EFFECTIVITY OF PGD MODEL REDUCTION

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Abstract

During the last few years, and due to the increasing number of multi-parameter simulation models, model reduction techniques have been the object of a growing interest in research and industry. In particular, an appealing technique based on separation of variables within a spectral resolution approach was recently introduced and successfully used in many applications of Computational Mechanics [1–3]; it is called *Proper Generalized Decomposition* (PGD). Contrary to POD, the PGD approximation does not require any knowledge on the solution; it operates in an iterative strategy in which basis functions (or modes) are computed on the fly, by solving simple problems that can be seen as pseudo-eigenvalue problems. However, the PGD is very effective for a class of problems only [4], and it is crucial to derive verification tools in order to control the quality of the approximate PGD solution.

After first works that developed error indicators in the PGD context [5], a verification approach was introduced to build guaranteed PGD-reduced models for linear elliptic or parabolic problems depending on parameters [6–7]. This approach is based on the concept of constitutive relation error and provides for strict bounds on both global error and error on outputs of interest. It also enables to assess contributions of various error sources (space and time discretizations, truncation of the PGD decomposition, etc.), which helps driving adaptive strategies.

In this work, we present new advances which have been performed in the PGD-verification method. These advances particularly enable to deal with problems with parameters of all kinds (material properties, geometry), or new linear problems on which verification tools had not been tested until now. Furthermore, they aim at setting up a non-intrusive procedure (solution of the adjoint problem, computation of admissible fields) in order to address implementation issues. Therefore, virtual charts associated with quantities of interest and computed from PGD models can now benefit fully from the verification method to satisfy a prescribed accuracy.

Reference

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