A Study on h and p Adaptivity for PGD Solutions
- Application to a 1D Linear Elastic Problem

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ABSTRACT

Computational methods have become an essential part of most high end engineering projects, greatly simplifying the analyzes and design tasks. Reduced order methods account for the essential parts of a simulation, decreasing the computational time while maintaining an acceptable level of accuracy in the results. The proper generalized decomposition (PGD) is one of the several methods based on the reduced order solution [1].

This work has the objective of showing the application of a PGD driven adaptivity process in a practical problem. We simultaneously seek two complementary PGD solutions, one compatible and one equilibrated, which we use to bound their error (as in [2]) and also to drive the adaptivity process (in the physical and in the parameter space).

We present the analytical and approximated solutions of an academic problem and we discuss the error assessment strategies for the approximated solutions, applying them to the adaptivity process. A sufficient number of terms is considered for the PGD approximations so that the truncation error is negligible. This enables a novel form of assessing the PGD solutions error, this time specific for each parameter, which is applied to obtain convergence rate estimations. We also present a novel error indicator for the adaptivity process, which can drive both an h- and p-adaptivity.

The convergence rates obtained are in agreement with the expected results according to [3]. The solutions for the adaptivity process show a high level of accuracy, providing evidence that the indicator is capable to drive an adaptivity process. The new adaptivity indicator and the parametric convergence rates proposed in this work assess the error of PGD approximations and are an additional step in the investigation of strategies to deal with the error sources in the PGD.

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