Accuracy control and non-intrusive implementation of Model Order Reduction based on Greedy Sampling for elasto-dynamics ADMOS 2017

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ABSTRACT

Parameterised problems have been widely studied for a long time and numerous of solutions have been provided to reduce the cost of repetitive computations. Model order reduction pursues this goal by storing and studying a sequence of pre-computations in an expensive "*offline*" stage, and makes use of these accumulated data to predict the solutions for parameterised problems in an "*online*" stage with extremely cheap cost [2].

Problems arise for conventional reduced model when the system undergo dynamic changes. First of all, a robust error estimate is needed for dynamic problems [1, 3]; moreover, the "*offline*" data requires a cost-effective procedure to locate the optimum set of sample parameters, such that the most representative reduced basis can be obtained. A robust sample selection process also keeps the "*offline*" cost under control.

In this paper, we will present an implemented Greedy sampling algorithm which aims on searching for the best reduced basis over a parameter domain in order to minimise the Frobenius norm of the *displacement error* $\underline{\boldsymbol{e}} = \mathcal{Q}\underline{\boldsymbol{E}} = \mathcal{Q}(\boldsymbol{A}^{-1}\underline{\boldsymbol{R}})$. This error estimate is robust as it allows the evaluation of error in the entire time domain rather than individual time step for parabolic problems. Greedy approach requires exact solutions over entire parameter domain, which is not practical. Instead, we develop a *dynamic operator* approximation $\widehat{\boldsymbol{A}^{-1}}$ to avoid the mass number of exact computations yet maintain the robustness of the new error estimate. Furthermore, a decomposition (in contrast to assembly) is performed to obtain a set of small scale responses, spectral reductions are applied on these responses to further reduce the cost. A comparison of low and high order interpolation scheme with local parameter domain *h-refinement* will give us an "*error in the error estimate*", which will be used to drive the adaptivity of Greedy algorithm.

We will prove the advantage and efficiency of the proposed method on complex test-cases, implemented in Abaqus/Matlab using a non-intrusive code coupling technique.

REFERENCES

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