A NEW HIERARCHICAL MODEL REDUCTION TECHNIQUE BASED ON REDUCED BASIS METHODS AND DIMENSIONAL SPLITTING

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ABSTRACT

In this contribution we deal with the dimension reduction of an elliptic problem. We develop our method in the framework of Ern, Perotto and Veneziani [1], which means that we split the domain in a dominant and a transversal direction. If one wants to deal for instance with groundwater flow, then the dominant direction would be the horizontal one and the transversal direction would be the vertical one. We use the Finite Element Method for the computations in the dominant direction and enrich the reduced space with basis functions on the transversal direction. For the choice of these basis functions we propose the application of the Reduced Basis Method. This means in our context that we use solutions of 1D problems as basis functions, whereas these problems are deduced from our original problem by choosing x and the approximation of the x-derivative of the solution as a parameter in the sense of the Reduced Basis Method. In order to find optimal basis functions we use a new basis enrichment technique based on a combination of the POD-Greedy-algorithm [2] with an adaptive hierarchical Voronoi tesselation of the parameter space. In this context we present an a posteriori error estimate, too. Numerical tests show that few basis functions already suffice to get a good approximation of the exact solution and that we get a reduction of the cpu time in comparison with a full Finite Element computation with the same resolution. That is why we see a great potential of our proposed method, particularly with regard to the application to complex problems in 3D, like groundwater flow.

REFERENCES

- [1] A. Ern,S. Perotto and A. Veneziani, Hierarchical model reduction for advection-diffusionreaction problems, *MOX-Report* **17/2008** (2008)
- B. Haasdonk and M. Ohlberger, Reduced basis method for finite volume approximations of parametrized linear evolution equations, *M2AN Math. Model. Numer. Anal.* 42, pp. 277-302 (2008)