6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Hierarchical Model Reduction for Parameter-Dependent Problems

Simona Perotto and Yves A. Brandes Costa Barbosa

MOX, Politecnico di Milano, simona.perotto@polimi.it, yvesbcb@gmail.com

Keywords: *Parametric Problems, Hierarchical Model Reduction, Proper Orthogonal Decomposition*

In many engineering applications model reduction techniques are frequently incorporated to compute, with a reasonable level of precision, the solution of partial differential equations in a constrained time and with a contained computational burden. In particular, our interest is for Hierarchical Model (HiMod) Reduction techniques [2]. HiMod downscales phenomena characterized by a preferential direction of flow (e.g., in the modelling of the blood flow in arteries or of the water flow in a channel network) by performing essentially a diverse numerical approximation of the axial and of the transverse components of the dynamics. The former is discretized via classical finite elements (or via an IsoGeometric Analysis, aka HIGAMod [3]), the latter by spectral methods. The method showed a significant improvement in reducing the computational power and simulation time, while giving enough information to analyze the problem at hand.

In this communication, we focus on the parametric generalization of HiMod, setting the so-called HiPOD formulation which merges the computational benefits of HiMod with the ones typical of a Proper Orthogonal Decomposition (POD) [1]. In particular, we will refer either to linear and nonlinear problems by setting ad-hoc procedures for both the cases. The results so far obtained, although preliminary, are very promising. Thus, after introducing the basic HiMod framework, we will focus on the HiPOD approach by verifying the corresponding performances on some benchmark configurations.

REFERENCES

[1] D. Baroli, C.M. Cova, S. Perotto, L. Sala and A. Veneziani. Hi-POD solution of parametrized fluid dynamics problems: preliminary results. In Model Reduction of Parametrized Systems. Series: MS&A Springer, P. Benner, M. Ohlberger, A.T. Patera, G. Rozza, K. Urban Eds., Chapter **15**, pp. 235–254, 2017.

[2] S. Perotto, A survey of hierarchical model (Hi-Mod) reduction methods for elliptic problems. In Numerical Simulations of Coupled Problems in Engineering. Series: Computational Methods in Applied Sciences, Vol. **33**, Springer, S.R. Idelsohn Ed., pp. 217–241, 2014.

[3] S. Perotto, A. Reali, P. Rusconi and A. Veneziani. HIGAMod: a Hierarchical IsoGeometric Approach for MODel reduction in curved pipes. *Comput. & Fluids*, Vol. **142**, pp. 21–29, 2017.