POD-DEIM based ROMs for CFD applications

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The ongoing developments in numerical mathematics and available computing power combined with the industrial needs promote a development of more and more complex models. However, such models are, due to their complexity, expensive from the point of view of the data storage and the time necessary for their evaluation. The reduced-order models (ROMs) provide an approach to an approximation of high-dimensional PDE-based models by low-dimensional ones.

We will go through the principles of the proper orthogonal decomposition (POD) and the discrete empirical interpolation method (DEIM) as they are currently one of the most used tools for the construction of the reduced-order models. We will also briefly outline how these two methods can be linked with the OpenFOAM, an open-source software specialized mainly in the field of the computational fluid dynamics (CFD). The OpenFOAM is a toolbox capable of solving even industrial scale problems. Hence, with a link between the OpenFOAM and methods for construction of ROMs, it is possible to test the applicability of POD-DEIM based ROMs on the real-life problems.

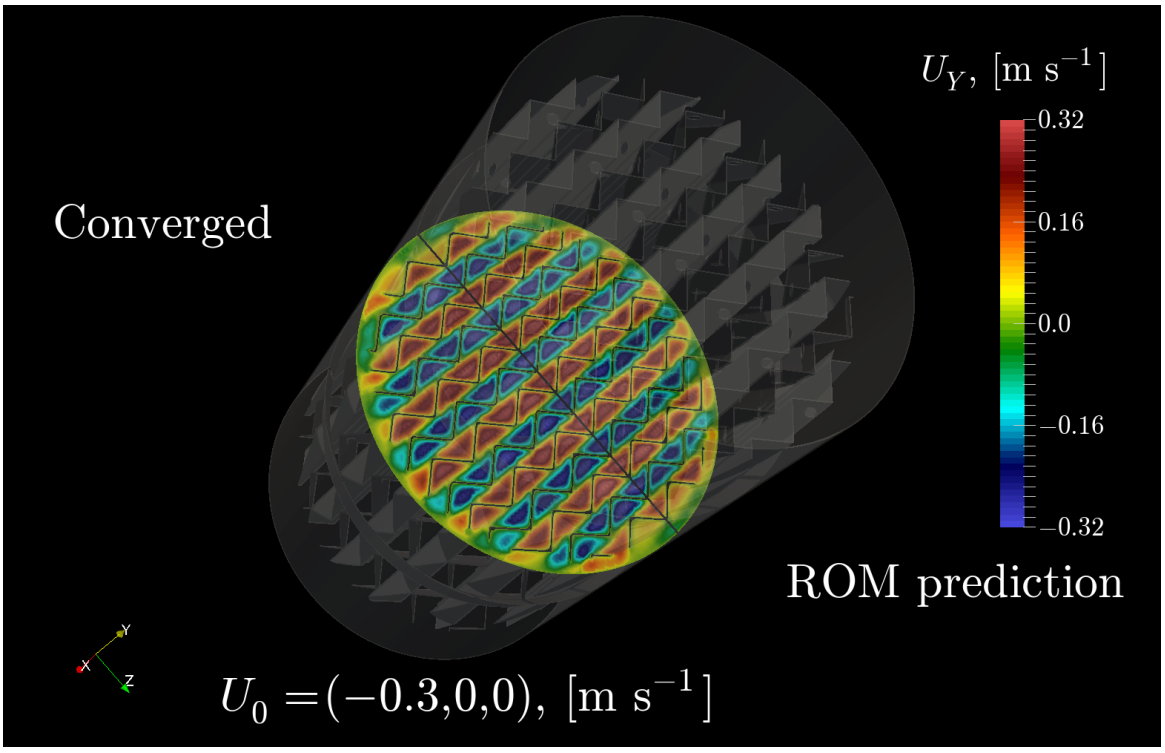

Figure 1: Comparison of the velocity field obtained from a full order model and from a POD-DEIM based ROM. The full model corresponds to the RANS simulation of a gas flow through the structured packing Mellapak 250.X. The simulation was performed in the OpenFOAM.

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