The PGD for Navier-Stokes flow in OpenFOAM

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ABSTRACT

The exploration of parametric solutions for flow problems is an essential part of the design cycle in the automotive industry. In such problems, where a large number of solutions are required, the use of conventional computational fluid dynamics (CFD) techniques is unfeasible.

Reduced order modeling (ROM) techniques are an efficient approach to the solution of parametric problems. This talk presents a methodology to implement the proper generalised decomposition (PGD) [2] for parametric Navier-Stokes flow problems in OpenFOAM, by considering parameters of the problem as extra dimensions of a generalised solution [3]. The ability of the PGD to build a reduced basis of the problem without prior knowledge of the solution is an advantage in an industrial environment. An important aspect of the proposed implementation of the PGD within OpenFOAM is the focus on minimum intrusion on the semi-implicit method for pressure-linked equations (SIMPLE) finite volume solver structure.

Flow control test cases with parametrically varying jet velocities are used to demonstrate the potential of the proposed methodology.

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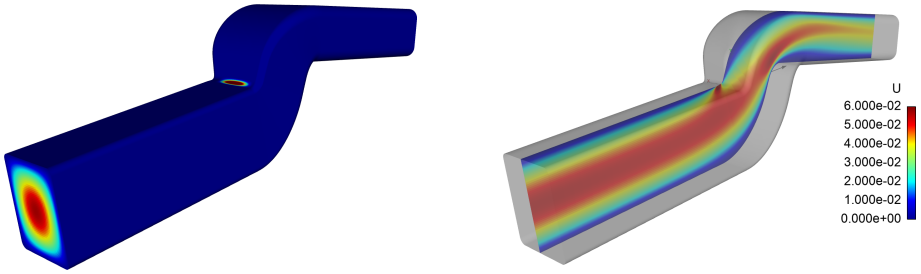

Figure 1: Velocity plot of S-bend duct with a suction jet at the first bend.

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