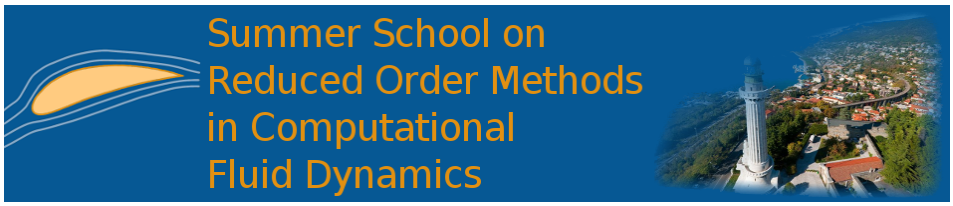

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A reduced order model for the optimisation-based domain decomposition algorithm for the incompressible Navier-Stokes equations

Keywords: Reduced Order Modelling, Proper Orthogonal Decomposition, Domain Decomposition, Optimal Control, Computational Fluid Dynamics

In the last few decades, there has been an explosion in the numerical analysis for Computational Fluid Dynamics, and many different methods have been proposed to solve Navier-Stokes equations numerically. Nevertheless, there is still an immense need to reduce the computational costs of the simulations. Domain Decomposition Methods and Reduced-Order Modelling are ones of such techniques. The former allows splitting the solves to usually much more computational simulations (due to solving problems of much smaller scales and usually with much simpler geometries) and the latter is an effective tool in the reducing cost of simulation of time-dependent and/or parametrised problem. In our work, we tried to combine both approaches. In particular, we consider an optimisation-based domain-decomposition algorithm for the parametrised incompressible Navier-Stokes equations and propose a reduced-order model for the resulting optimal control problem. The reduced-order model for the optimisation is based on the Proper Orthogonal Decomposition technique and the presented methodology is tested on the stationary backward-facing step and lid-driven cavity flow fluid dynamics test cases. The simulations showed great performance in the sense of drastically reducing both the dimension of the resulting optimisation and the number of iterations of the optimisation algorithm.

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