Tuesday 9 April 2019 – at 3:00 p.m.
Seminar Room “-1” – Department of Mathematics

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POD-Galerkin reduced order methods for combined Navier-Stokes transport equations based on a hybrid FV-FE solver

Abstract:
Many real-time processes require the resolution of complex time-dependent computational fluid dynamics problems. To develop a computational tool allowing us to reduce the cost of a simulation of classical full order methods (FOM) we may apply reduced order models (ROM). In this talk, we will present a novel POD-Galerkin strategy based on a semi-implicit hybrid finite volume/finite element solver of the incompressible Navier-Stokes equations coupled with an additional transport equation.

The main idea behind ROM is to decompose the computation of the solution into an offline and an online stage. Within the offline stage, the full-order model is used to compute the solution of the problem for a large set of time instants. Then, we assume that the approximated solutions can be expressed as a linear combination of spatial modes and we perform a proper orthogonal decomposition (POD) to select the most energetic and construct the basis. Regarding the online stage, we set the dynamical system which has as solution the values of the coefficients of the linear combination which corresponds with the values of the chosen parameter. Finally, we reconstruct the solution by using the computed coefficients and the modes included in the POD basis. We apply this procedure taking into account the unstructured staggered mesh and the FV-FE formulation used on the FOM. They are conveyed to the ROM leading to the definition of reduced basis spaces in both meshes. Aiming at assessing the performance of the developed methodology, we will analyse the results obtained for a manufactured three-dimensional test case and for a modified version of the classical cavity benchmark including the transport of a species.

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