NEW DIRECTIONS FOR SOLVING STOKES AND NAVIER-STOKES PROBLEMS

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ABSTRACT

In fluid dynamics, designing accurate numerical schemes or solvers is a challenging issue. The Navier-Stokes equations are non-linear partial differential equations that describe the motion of fluids [1]. In the case of Newtonian flows, the non-linear term vanishes and one can solve the Stokes problem. On the one hand, the Stokes problem can accurately model creeping flows. On the other hand, the study of Stokes problem helps to build an appropriate approximation of the Navier-Stokes equations. Indeed, it is well-known that poor mass conservation in the numerical scheme leads to instabilities, which are amplified when solving the Navier-Stokes equations. Thus, the search for a robust discretization of the Stokes problem is a preliminary step to solving the Navier-Stokes equations. We propose to study these problems from three complementary angles: theoretical, technical and modelling. In particular, the following issues will be addressed for Stokes problem: Dirichlet control on non-smooth boundaries, new variational formulations via T-coercivity, nonconforming Crouzeix-Raviart finite elements method with enriched discrete pressure space (applied to an industrial CFD solver). Concerning Navier-Stokes equations, we will focus on the modelling of the fluid dynamics of fuel cell channels and on model reductions of fluid flows in biological media.

Five prospective European speakers:

Pr. Th. Apel, Universität der Bundeswehr München, Germany.

Pr. P. Ciarlet, Jr., ENSTA Paris, Institut Polytechnique de Paris, France.

Dr. E. Jamelot, Université Paris-Saclay, CEA, France.

Dr. P. Mollo, Eindhoven University of Technology, Netherlands.

Dr. R. Tittarelli, FEMTO-ST Institute, Université de Bourgogne Franche-Comté, France.

REFERENCES

[1] V. Girault and P.-A. Raviart. Finite element methods for Navier-Stokes equations. Springer-Verlag, 1986.