Preconditioning of Large-Scale Saddle Point Systems for Coupled Flow Problems

Heiko Weichelt

PhD student at Max Planck Institute for Dynamics of Complex Technical Systems Magdeburg, Germany

In order to explore boundary feedback stabilization of coupled flow problems, we consider the Navier-Stokes equations that describe instationary, incompressible flows coupled with a diffusion convection equation. Using a standard finite element discretization, we get a differential-algebraic system of differential index two. We show how to reduce this index with a projection method to get a generalized state space system, where a linear quadratic control approach can be applied.

This leads to large-scale saddle point systems which have to be solved in a threefold nested iteration. For obtaining a fast iterative solution of those nonsymmetric systems, we derive efficient preconditioners based on the approaches due to Wathen et al. [Elman/Silvester/Wathen 2005, Stoll/Wathen 2011]. Finally, we show recent numerical results regarding the arising nested iteration.