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Efficient Solution of Large-Scale Saddle Point Systems Arising in Feedback Control of the Stokes Equations (Student Paper)

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To explore feedback control of flow problems we consider the Stokes equations that describe instationary, incompressible flows for low Reynolds numbers. After 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. For obtaining a fast iterative solution of those systems we derive efficient preconditioners based on the approaches due to Wathen et al. [ELMAN/SILVESTER/WATHEN 2005, STOLL/WATHEN 2011]. The main results can be extended to non-symmetric Navier-Stokes equations.

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