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Preconditioners for stabilized finite element discretizations of the steady incompressible Navier-Stokes equations

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In this talk we consider block preconditioners for stabilized saddle point systems arising from incompressible flow problems. Our focus is on block triangular preconditioners based on the augmented Lagrangian formulation. These techniques have been shown to be remarkably robust and effective when applied to linear systems arising from inf-sup stable mixed finite element discretizations of the Stokes and Oseen problems. Indeed, with an appropriate choice of the augmentation parameter these preconditioners result in rates of convergence that are independent of the mesh size and largely insensitive to the value of the viscosity; see [1,2].

In this talk we describe a (non-trivial) extension of the augmented Lagrangian-based block preconditioners to the case of stabilized finite elements, e.g., Q1-Q1 and Q1-P0 elements. We also describe an inexpensive technique for estimating the optimal value of the augmentation parameter. This technique is applicable to both stable and stabilized finite element schemes.

This is joint work with Maxim Olshanskii (Moscow State University) and Zhen Wang (Emory University).

References

[1] M. Benzi and M. A. Olshanskii, *An augmented Lagrangian-based approach to the Oseen problem*, SIAM J. Sci. Comput., 28 (2006), pp. 2095-2113.

[2] M. Benzi, M. A. Olshanskii and Z. Wang, *Modifed augmented Lagrangian preconditioners for the incompressible Navier-Stokes equations*, Int. J. Numerical Methods in Fluids, in press.