New block preconditioners for saddle point problems

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In this talk I will describe a class of block preconditioners for linear systems in saddle point form. The main focus is on the solution of Stokes and Oseen problems from incompressible fluid dynamics; however, the techniques can be applied to other saddle point problems as well. The main idea is to split the coefficient matrix into the sum of two matrices (three for 3D problems), each of which contains only operators corresponding to components of the solution associated with one space variable. The resulting preconditioner requires the (uncoupled) solution of discretized scalar elliptic PDEs, which can be accomplished using standard algebraic multilevel solvers. The performance of the preconditioner can be improved by means of a relaxation parameter, which can be chosen on the basis of a local Fourier analysis.

The robustness of these preconditioners with respect to problem parameters will be discussed, together with the effect of inexact solves.

This is joint work with Michael Ng, Qiang Niu and Zhen Wang.

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