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An Augmented Lagrangian Approach for the Oseen Problem

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We describe an effective solver for the discrete Oseen problem based on an augmented Lagrangian formulation of the corresponding saddle point system. The proposed method is a block triangular preconditioner used with a Krylov subspace iteration (BiCGStab). The crucial ingredient is a novel multigrid approach for the (1,1) block, which extends a technique introduced by Schöberl for elasticity problems to nonsymmetric problems. Our analysis indicates that this approach results in fast convergence, independent of the mesh size and largely insensitive to the viscosity. We present experimental evidence for both isoP2-P0 and isoP2-P1 finite elements in support of our conclusions. We also show results of a comparison with a state-of-the-art coupled multigrid solver, showing the competitiveness of our approach.