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Preconditioned Schemes for Nonsymmetric Saddle-Point Problems

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In this talk, we present a nested preconditioning technique for solving nonsymmetric saddle-point problems. In particular, we consider those saddle-point problems that arise from the numerical solution of the mixed finite element discretization of particulate flows - flow of solid particles in incompressible fluids. These indefinite linear systems are solved using a preconditioned Krylov subspace method with an indefinite preconditioner. This creates an inner-outer iteration in which the inner iteration is handled via a preconditioned Richardson scheme. We provide an analysis of our approach that relates the convergence properties of the three nested iterations. Also, "optimal" approaches are proposed for the construction of the preconditioner of the inner Richardson iteration. The analysis is validated by numerical experiments that demonstrate the robustness of our nested iteration scheme, its lack of sensitivity to changes in the fluid-particle system, and its "scalability".