An Implicit Approximate Inverse Preconditioner For Saddle Point Problems

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Large linear systems of saddle point type arise in a wide variety of applications. In recent years, a large amount of work has been devoted to develop preconditioners for the iterative solution of these systems, often taylored to specific applications. Several of these preconditioners are based on a block LU factorization of the system matrix and require the (approximate) solution of a Schur complement problem or other subproblems which imply the solution of dense linear systems of equations.

In this talk, we will introduce a new preconditioner that yields an implicit approximation to the inverse of the system matrix. In particular, this new preconditioner does not require the solution of a Schur complement problem but rather the (approximate) solution of a div-grad type problem. We will provide some theoretical properties of this preconditioner and show some interesting connections with other preconditioners from the literature. We will conclude with numerical results that illustrate the performance of the preconditioner in various test cases in two and three spatial dimensions.