

Preconditioning techniques for highly indefinite systems

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Abstract

Many practical situations require the solution of highly indefinite linear systems of equations. Among these are systems which arise from the Helmholtz equation or the very irregularly structured systems that are obtained from circuit simulation for example. This talk will discuss preconditioning techniques which emphasize robustness. One such technique is based on combining two-sided permutations with a multilevel approach. The nonsymmetric permutation technique exploits a greedy strategy to put large entries of the matrix in the diagonal of the upper leading submatrix. This leads to an effective incomplete factorization preconditioner for general nonsymmetric, irregularly structured, sparse linear systems. The algorithm is implemented in a multilevel fashion and borrows from the Algebraic Recursive Multilevel Solver (ARMS) framework. Preliminary parallel implementations using a Domain Decomposition framework will also be discussed. Illustrations with the Helmholtz equations and problems arising from an application in quantum transport will be reported.