A Robust Multilevel Approximate Inverse Preconditioner for Symmetric Positive Definite Matrices

Andrea Franceschini [1]

The use of factorized sparse approximate inverse (FSAI) preconditioners in a standard multilevel framework for symmetric positive definite (SPD) matrices may pose a number of issues as to the definiteness of the Schur complement at each level. The present work introduces a robust multilevel approach for SPD problems based on FSAI preconditioning, which eliminates the chance of algorithmic breakdowns independently of the preconditioner sparsity. The Multilevel FSAI algorithm is further enhanced by introducing Descending and Ascending Low-Rank corrections, thus giving rise to the MFLR preconditioner. The proposed algorithm is investigated in a number of test problems. The numerical results show that the MFLR preconditioner is a robust approach that can significantly accelerate the solver convergence rate preserving a good degree of parallelism. The possibly large set-up cost, mainly due to the computation of the eigenpairs needed by Low-Rank corrections, makes its use attractive in applications where the preconditioner can be recycled along a number of linear solves.

[1]University of Padova, Italy (franc90@dmsa.unipd.it)