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A factorized sparse approximate inverse preconditioner for symmetric indefinite linear systems

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We propose a factorized sparse approximate inverse preconditioner for large real symmetric and indefinite linear systems. Factorized approximate inverse preconditioners have been developed and used successfully for symmetric positive definite and many nonsymmetric linear systems, but it remains challenging to construct effective preconditioners of this type in the symmetric and indefinite setting. In this study, we show that whether the coefficient matrix is close to diagonally dominant tends to have a greater impact on the density of factorized approximate inverses than the inertia itself. To enhance the diagonal dominance, we use HSL's symmetric MC64 subroutine for preprocessing, which scales and relocates large entries to super- and sub-diagonals near the diagonal. Our main incomplete conjugation algorithm uses the Bunch-Kauffman partial pivoting. A sparsest-columns-first dynamic reordering is proposed and shown effective for maintaining the sparsity of the factorized preconditioners. Numerical results are provided to illustrate the effectiveness of the new preconditioner and its potential to be a competitive alternative to incomplete LDL^T preconditioners, especially on parallel computers.