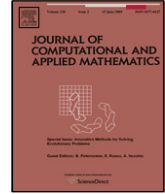




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Breakdown-free version of ILU factorization for nonsymmetric positive definite matrices

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ABSTRACT

In this paper a new ILU factorization preconditioner for solving large sparse linear systems by iterative methods is presented. The factorization which is based on *A*-biorthogonalization process is well defined for a general positive definite matrix. Numerical experiments illustrating the performance of the preconditioner are presented. A comparison with the well known preconditioner RIF_p of Benzi and Tuma is also included.

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1. Introduction

In this paper we consider the solution of linear systems of the form

$$Ax = b, \quad (1)$$

where the coefficient matrix $A \in \mathbb{R}^{n \times n}$ is large, sparse and nonsymmetric positive definite (NSPD), and b is a given right hand side vector using preconditioned conjugate gradient-type methods. Suppose that A admits the factorization

$$A = LDU, \quad (2)$$

where L, U^T are unit lower triangular matrices and D is a diagonal matrix. If \bar{L} and \bar{U}^T are sparse unit lower triangular matrices approximating (in some sense) the matrices L and U^T , respectively, and \bar{D} is a nonsingular diagonal matrix approximating D , then we say that matrix M with

$$M = \bar{L}\bar{D}\bar{U} \approx A, \quad (3)$$

is an incomplete LU (ILU) factorization preconditioner for matrix A . The transformed linear systems

$$AM^{-1}u = b, \quad M^{-1}u = x, \quad (4)$$

or

$$M^{-1}Ax = M^{-1}b, \quad (5)$$

have the same solution as system (1) and seem to be better-conditioned than the original system (1) to solve. It is well-known that an incomplete factorization of a general matrix A may fail due to the occurrence of zero pivots, regardless of

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