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Pivoting strategy for an ILU preconditioner

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Abstract

In this paper, a complete pivoting strategy for the right-looking version of $RIF-NS$ preconditioner is presented.

Keywords: preconditioning, pivoting, right-looking version of $RIF - NS$ preconditioner
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1 Introduction

Consider the linear system of equations of the form $Ax = b$, where the coefficient matrix $A \in \mathbb{R}^{n\times n}$ is nonsingular, large, sparse and nonsymmetric and also $x, b \in \mathbb{R}^n$. An ILU preconditioner M of this system is in the form of $M = LDU \approx A$. This preconditioner will change the original system to the left preconditioned system $M^{-1}Ax = M^{-1}b$. For a proper preconditioner, instead of solving the original system, it is better to solve the left preconditioned system by the Krylov subspace methods [3]. In [1], we have proposed an ILU preconditioner for system $Ax = b$. This preconditioner is termed the $RIF - NS$ and has two left- and right-looking versions.

2 Pivoting strategy for the right-looking $RIF - NS$ preconditioner

Algorithm 1, uses the complete pivoting strategy to compute the right-looking version of $RIF - NS$ preconditioner. Here we explain the step i of this algorithm. At the beginning of this step, $\Pi = \Pi_{i-1}...\Pi_1$ and $\Sigma = \Sigma_1...\Sigma_{i-1}$ are the row and the column permutation matrices, respectively. For $k < i$, the matrices Π_k and Σ_k are the row and the column permutation matrices associated to step k of this algorithm. At the beginning of this step, the parameters m_i, n_i, $iter$, $satisfied\_p$ and $satisfied\_q$ are initialized in line 3. At the end of this step, m_i and n_i will be the total number of row and column pivoting associated to step i. The parameter $iter$ is used to compute the pivot entry in this step. $satisfied\_p$ ($satisfied\_q$) shows whether or not we need to the row (column) pivoting strategy. In line 7 of the algorithm, the vector $(q_i^{(i-1)}, \cdots, q_n^{(i-1)})$ is computed. Suppose that $|q_k^{(i-1)}| = max_{m\geq i+1}|q_m^{(i-1)}|$. If the criterion $|q_i^{(i-1)}| < \alpha\, |q_k^{(i-1)}|$ is satisfied for

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