Available online at www.sciencedirect.com
ScienceDirect
Journal of Computational and Applied Mathematics 219 (2008) 72–80
JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS
www.elsevier.com/locate/cam

New breakdown-free variant of AINV method for nonsymmetric positive definite matrices

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Received 2 February 2007

Abstract

This paper proposes a new breakdown-free preconditioning technique, called SAINV-NS, of the AINV method of Benzi and Tuma for nonsymmetric positive definite matrices. The resulting preconditioner which is an incomplete factorization of the inverse of a nonsymmetric matrix will be used as an explicit right preconditioner for QMR, BiCGSTAB and GMRES(m) methods. The preconditoner is reliable (pivot breakdown can not occur) and effective at reducing the number of iterations. Some numerical experiments on test matrices are presented to show the efficiency of the new method and comparing to the AINV-A algorithm.
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MSC: 65F10

Keywords: Factored approximate inverses; AINV; SAINV and AINV-A methods; Preconditioning; Krylov subspace methods; Sparse matrices

1. Introduction

In many areas of scientific computing it is needed to solve the linear system of equations

$$Ax = b,$$

where the coefficient matrix $A \in \Re^{n\times n}$ is large and sparse. There has been proposed many iterative methods with respect to the property of the coefficient matrix being symmetric or nonsymmetric. But in many cases the iterative methods suffer from the slow convergence results. It has been recognized that the performance of these methods can be improved by using suitable preconditioner [9]. The preconditioners examined in this paper are sparse approximate inverses in factored form.

A sparse approximate inverse preconditioner is a sparse matrix M that directly approximates the inverse of the coefficient matrix A, $M \approx A^{-1}$. The preconditioned system is therefore of the form:

$$AMu = b, \quad x = Mu$$

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doi:10.1016/j.cam.2007.07.003