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Application of Eisenstat-SSOR Preconditioner to Realistic Stress Analysis Problems by Parallel Cache-Cache Computing

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Abstract. We are to solve a linear system of equations which arise from discretization of realistic stress analysis problems by Krylov subspace (KS) methods such as the Conjugate Gradient (CG) method and the AZMJ variant of ORTHOMIN(2). It is important to use effective preconditioners with the KS methods to rapidly and successfully solve the linear equations. However some of the preconditioners do not often work well, and the speed-up obtained by parallel computing deteriorates when using preconditioning. We therefore try to apply CG and AZMJ with an Eisenstat type of Symmetric SOR preconditioner (abbreviated as E-SSOR) for parallel computing to the realistic stress analysis problems, and then examine the effectiveness of E-SSOR and the parallel performance. The numerical experiments demonstrate that AZMJ and CG using E-SSOR for parallel computing are useful for obtaining rapid and successful convergence on the stress analysis problems, and the good speed-up can be gained by E-SSOR on parallel computer. The convergence behavior of AZMJ is superior to that of CG, and the parallel performance of AZMJ, which has the less number of synchronization points than CG, using the hybrid parallelization is higher on the parallel computer.

Keywords. Krylov subspace methods, linear equations, hybrid parallelization, parallel computer, symmetric SOR preconditioner

1. Introduction

Numerical methods are useful for analyzing realistic stress analysis problems such as a construction machinery design. In these cases, we need to efficiently solve a linear system of equations

$$A\boldsymbol{x} = \boldsymbol{b} \tag{1}$$

which arise from discretization of the stress analysis problems. Here $A \in \mathbf{R}^{n\times n}$ is a given coefficient matrix and $\boldsymbol{b} \in \mathbf{R}^n$ is a given vector. We use Krylov subspace (KS) meth-

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