Cache-Cache Elements parallel technique for MrsR iterative method

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ABSTRACT

We have proposed MrsR (Minimized Residual method based on Shadow three-term Recurrence) method for efficiently solving linear systems with symmetric matrix [2]. This MrsR method has single global synchronization per an iteration on parallel computers with distributed memory. Then high speed-up ratio of the MrsR method was verified through many numerical experiments.

Moreover, we have proposed a new Cache-Cache Balancing technique for Eisenstat preconditioning [1] for parallel computers with shared memory, and applied this technique to the IDR(s) based iterative method [3] for solving linear systems with non-symmetric matrix. Then fairly high speed-up ratio was gained on thread processors.

On the other hand, Eisenstat preconditioning is an excellent one in view of convergence rate and robustness of convergence on serial computers. This preconditioning, however, needs substantially forward and backward substitutions in the computation of preconditioned matrix. Then, Eisenstat preconditioning has a slight disadvantage in its application to large scaled problems.

In this article, we propose the highly parallelized version of MrsR method with Eisenstat preconditioning by utilizing Cache-Cache Elements technique. Moreover, we will verify high performance of the above preconditioned MrsR method by using Cache-Cache Elements technique on parallel computers with distributed memory.

REFERENCES

[1] Eisenstat, S. C.: Efficient implementation of a class of preconditioned conjugate gradient methods, SIAM J. Sci. Stat. Compute., Vol.2, pp.1-4, 1981.
[2] Fujino, S.: A proposal of MrsR method with one global synchronization per one iteration, PMAA'12, 7th Int. Workshop on Parallel Matrix Algorithms and Applications, Birkbeck University of London, U.K., 28-30 June, 2012.
[3] Fujino, S., Itoh, C.: Cache-Cache balancing technique for Eisenstat type of preconditioning for parallelism, PMAA'14, 8th Int. Workshop on Parallel Matrix Algorithms and Applications, Lugano, Switzerland, 2-4 July, 2014.