An efficient implementation of parallel Scaled-BDD method

for large-scale structural analysis

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Abstract

Actual problems in science and industrial applications are modeled by complex shape and composite materials. To solve these problems, the finite element analysis with large-scale unstructured mesh has been widely used on various parallel computers. Moreover, the iterative methods such as the Krylov subspace method has been usually used for large-scale linear systems. However, solving large-scale linear systems from actual problems suffer from slow or no convergence. Therefore, numerical methods having both robust convergence and scalable parallel efficiency are in great demand.

The domain decomposition method (DDM) is well known as an iterative substructuring method, and is an efficient approach for parallel finite element methods. As a preconditioner for the DDM, the balancing domain decomposition (BDD) method [1] have robust convergence for the number of subdomains and is expected to be high convergence rate. However, the BDD method is known that the convergence becomes bad in case of problems consisting of very different materials such as Young modulus and mass density. To solve this issue, a BDD method combined with the diagonal scaling preconditioner (Scaled-BDD) [2] has been proposed.

This study focuses on an efficient implementation of parallel Scaled-BDD method. Some numerical results are demonstrated to indicate that the Scaled-BDD method has both robust convergence and high parallel efficiency on the Fujitsu PRIMEHPC FX100.

Keywords: Balancing domain decomposition, Domain decomposition method, Parallel computing.

References

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