BALANCING DOMAIN DECOMPOSITION SOLVER FOR COMPLEX MODELS OVER MILLIONS OF DOFS

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We have been developing a parallel finite element analysis system based on the Hierarchical Domain Decomposition Method (HDDM) [1] with a preconditioned iterative solver [2]. The preconditioner is formulated by the Balancing Domain Decomposition (BDD) [3]. Several researchers have studied applications of the BDD to various phenomena but it is difficult to apply to large-scale problems with high performance, because the degrees of freedom of a coarse space increase in proportion to the number of subdomains.

In order to solve the issue, we have developed a version of the BDD system, which employs an incomplete parallel linear solver for a coarse problem. In this system, a coarse grid operator is factorized incompletely, and then a coarse problem is solved with the incomplete operator directly. Although it increases the number of iterations with the incomplete operator, it can decrease the computational time overall with lower computational costs and higher parallel efficiency.

The present system is successfully applied to static elastic analysis of a precise three-dimensional model of a nuclear reactor vessel with over 30 million degrees of freedom mesh on the Hitachi SR8000/MPP with 1,024 processors, and achieved high performances, with over 14% of peak FLOPS and over 99.9% parallel efficiency.

References

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