Preconditioner Construction for Magnetostatic Domain Decomposition Analysis

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An iterative domain decomposition method is proposed for numerical analysis of 3-Dimensional (3D) linear magnetostatic problems taking the magnetic vector potential as an unknown function. The iterative domain decomposition method is combined with the Preconditioned Conjugate Gradient (PCG) procedure and the Hierarchical Domain Decomposition Method (HDDM) which is adopted in parallel computing. Our previously employed preconditioner was the Neumann-Neumann preconditioner. Numerical results showed that the method was only effective for smaller problems. In this presentaion, we consider its improvement with the Balancing Domain Decomposition (BDD) preconditioner.

In the present research, it is very important for us to reduce number of iterations and computation time. As one possibility, we are trying to implement the Neumann-Neumann preconditioner with a coarse problem which has been successfully used in structural analysis [1] where the null space $Null\ K^{(i)}$ expresses the rigid body motion which consists of translation and rotation, in thermal analysis [2] where the null space becomes a vector whose components are the same constant and in incompressible viscous flow analysis [3] where the null space expresses translation like moving. These analyses allow the similar approach to the above $Z^{(i)}$ construction and numerical evidences for effectiveness of BDD preconditioners (iteration counts, computation time, convergence as a function of the number of subdomains and so on) are shown in [1]-[3]. Therefore, for magnetostatic problems, the present approach in this presentation is expected to be also effective [4].

Keywords: Large-scale magnetostatic problems, DDM, Preconditioning, Parallel computation

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