A Preconditioner for Substructuring Based on Constraints and Energy Minimization

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Abstract

A preconditioner for substructuring based on constraints and energy minimization concepts is presented. The preconditioner is applicable to either structured and unstructured meshes and offers a straightforward approach for the iterative solution of second and fourth-order structural mechanics problems. The approach is centered around a set of constraints involving deformations of the substructure boundaries. These constraints provide the means for preconditioning at both the substructure and global levels.

The method has many similarities with a dual-primal version of FETI called FETI-DP, but there are some important differences. For one, the primary variables for iterative solution are displacements rather than Lagrange multipliers. An important result of using a displacement formulation is that the coarse problem looks very much like the original problem. Consequently, multilevel extensions for very large problems are straightforward.

Numerical examples are presented which demonstrate the good numerical performance of the method in terms of iterations and condition numbers of the preconditioned equations. The examples include both scalability studies and analyses of more realistic problems. Practical details regarding implementation of the method are also discussed. An accompanying theory for the method has been developed and will be presented in another talk.

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