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Parallel Performance of Algebraic Multigrid Methods for Structural Dynamics

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Multigrid preconditioning have been demonstrated to be efficient solution techniques for many scientific problems. The idea of multigrid is to capture errors at different scales by using grids of different fineness. By traversing and relaxing between the fine and the coarse grids, optimal convergence rates are often observed. In adidition, the computation on each grid can be performed in parallel, making it relatively suitable for parallel implementation (the degree of parallelism, however, decreases rapidly with coarser grids). The difficulties in using geometric multigrid for unstructured grid problems have prompted the development of algebraic multigrid methods.

In this talk we present a study of parallel performance for a number of algebraic multigrid (AMG) methods on a few selected structural mechanics problems. The first one is the classical algebraic multigrid by Ruge and Stuben. This classical AMG has been implemented in the HYPRE solver library with many modifications for parallel computations. A second AMG method is the smoothed aggregation method proposed by Vanek, Brezina, and others. We also introduce a substructure-based aggregation AMG method that uses local eigenvector information for construction prolongation operators for smoothed aggregation multigrid. We will discuss scalability and robustness issues with these algebraic multigrids.

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