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Improving coarsening and interpolation for algebraic multigrid

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Algebraic multigrid (AMG) is one of the most efficient algorithms for solving large sparse linear systems on unstructured grids. Classical coarsening schemes such as the standard Ruge-Steuben method [1] can lead to adverse effects on computation time and memory usage that affect scalability. Memory and execution time complexity growth is remedied for various large three-dimensional (3D) problems using the parallel modified independent set (PMIS) coarsening strategy developed by De Sterck, Yang, and Heys [2]. However, this coarsening strategy often leads to erratic grids without a regular structure that diminish convergence. This talk looks at a modification of the PMIS algorithm that consistently produces more uniform coarsenings, and significantly improves convergence properties over the original PMIS algorithm. Improvements of existing interpolation schemes and application of the resulting methods to several problems are also examined.

[1] J. Ruge, K. Stueben, Algebraic multigrid (AMG), in: S. McCormick, ed., Multigrid Methods, vol. 3 of Frontires in Applied Mathematics (SIAM, 1987) 73-130.

[2] H. De Sterck, U. M. Yang, and J. J. Heys, Reducing Complexity in Parallel Algebraic Multigrid Preconditioners, SIAM Journal on Matrix Analysis and Applications, to appear, 2006.