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Reducing Complexity in Algebraic Multigrid

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Algebraic multigrid is a very efficent algorithm for solving large linear problems on unstructured grids. Use of coarsening schemes such as parallel variants of the standard coarsening algorithm by Ruge and Stueben [1] or CLJP coarsening [2], a method based on parallel maximal independent set algorithms, can lead to high complexities with regard to memory usage as well as computation time, which adversely affect scalability. Aggressive coarsening techniques [3], which require long range interpolation techniques, significantly reduce complexities. While use of these methods often leads to worse convergence rates, overall savings in total time due to the reduced complexity can be significant.

In this talk, we investigate some new aggressive coarsening techniques, multipass interpolation and their implementation on a parallel computer. The resulting AMG methods are applied to first-order system least-squares (FOSLS) discretizations of elliptic PDE systems. To this end, John Ruge's serial FOSLS code FOSPACK was parallelized and coupled to the hypre solver library [4]. Parallel scalability of the combined FOSLS-AMG method is investigated for large-scale three-dimensional applications.

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