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**Parallel Efficiency Based Adaptive Local Refinement**

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We propose a new adaptive local refinement (ALR) strategy, the goal of which is to reach a given error tolerance with the least amount of computational cost. This strategy is especially attractive in the setting of a first-order system least-squares (FOSLS) finite element formulation in conjunction with algebraic multigrid (AMG) methods in the context of nested iteration (NI). To accomplish this, the refinement decisions are determined based on minimizing the predicted ‘accuracy-per-computational-cost’ efficiency (ACE). The nested iteration approach produces a sequence of refinement levels in which the error is equally distributed across elements on a relatively coarse grid. Once the solution is numerically resolved, refinement becomes nearly uniform.

This talk will first describe the algorithm and demonstrate its efficiency on a simple test problem. Then, modifications that yield an efficient parallel algorithm will be discussed. These involve a geometric binning strategy to reduce communication cost. Load balancing begins at coarse levels using a parallel quad-tree and a space filling curve. We show that this automatically ameliorates load balancing issues at finer levels.