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Alternative RAP

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General geometric multigrid codes, like BOXMG, and algebraic multigrid codes, like LAMG, employ Galerkin coarsening to form the coarse grid operators. That is, if the fine grid operator is A, then the coarse gird operator is RAP, where P is the prolongation, or interpolation, operator, from the coarse grid to the fine grid, and where R is the restriction operator from the fine grid to the coarse grid. BOXMG, as well as other such structured codes, employs a closed form expression for RAP. An alternative is to form RAP by placing 1 at only one coarse grid point, and 0 at all other coarse gird points, then applying P, A, and R recursively; the result is RAP at that coarse grid point. This alternative is useful for some theoretical investigations but is obviously too expensive for practical calculations. This paper explores the idea of doing this calculation locally using temporary 7×7 [in two dimensions] or $7 \times 7 \times 7$ [in three dimensions] matrices. Initial investigations have shown this method to be just as fast as the original method for compiler-optimized serial computation. The real advantage of the new method, however, is its simplicity in comparison with the old method. We expect this simplicity to result in more flexible and efficient computation on parallel architectures. We will report on the realization of this expectation.

LAMG, and other algebraic multigrid codes, employ sparse matrix multiplication techniques, to form the triple product RAP. We are currently investigating whether a generalization of the above procedure can be applied in this case as well.