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Progress on Improving the Parallel Scalability of BoxMG

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Black Box Multigrid (BoxMG) is a variational multigrid method for discretizations of PDEs on logically structured grids. BoxMG uses operator-induced interpolation, making it robust for problems with discontinuous coefficients and general boundary conditions on grids of any dimension (i.e., non-power-of-two grids). Like most structured multigrid methods, BoxMG uses the structure of the problem to yield notable performance advantages such as direct memory access and bounded complexity in the coarse grid operator. Yet, while current parallel BoxMG implementations scale well out to thousands of cores, the coarse grid solve and line-relaxation limit further scalability. In the plasma applications of interest, grid stretching creates an anisotropic diffusion operator, and hence, with standard coarsening line-relaxation is required. The current coarse-grid solve strategy first collects the coarse problem to a single core. The coarse problem is then solved using serial BoxMG. To extend the scalability of the coarse-grid solve, we look at redistributing the problem on coarser levels to provide redundancy while minimizing communication costs. In this talk, we give an overview of the current state of BoxMG including a new control layer. We will show our progress in addressing the coarse-grid scalability limitations, specifically in the context of electric field calculations on curvilinear meshes.