

Parallel-in-Time Solution of Hyperbolic PDE Systems via Characteristic-Variable Block Preconditioning

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The multigrid reduction in time (MGRIT) method is a parallel multigrid-in-time solver designed to be as non-intrusive as possible and take advantage of existing simulation codes and techniques. This has worked well for parabolic equations, but parallel-in-time methods for advection-dominated hyperbolic problems have proven difficult to develop. In earlier work, we demonstrated the effectiveness of a modified semi-Lagrangian coarse-grid operator for speeding up the parallel solution of high-order discretizations of variable-wave-speed linear advection problems in both 1D and 2D. We also extended this technique for solving nonlinear hyperbolic conservation laws, including the inviscid Burgers and Buckley-Leverett equations. In this talk, we will present developments for solving systems of hyperbolic PDEs based on a characteristic-variable block preconditioning approach, with numerical results for the acoustic equations, shallow water equations, and Euler equations.