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Multigrid Reduction in Time: Recent theoretical results

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The need for parallel-in-time is being driven by changes in computer architectures, where future speedups will be available through greater concurrency, but not faster clock speeds, which are stagnant. This leads to a bottleneck for sequential time marching schemes, because they lack parallelism in the time dimension. In this talk, we examine an optimal-scaling parallel time integration method, multigrid-reduction-in-time (MGRIT). MGRIT applies multigrid to the time dimension by solving the (non)linear systems that arise when solving for multiple time steps simultaneously. The result is a versatile approach that is nonintrusive and wraps existing time evolution codes. In this talk, we present the MGRIT framework and then discuss some recent theoretical convergence results. Some typical simplifying assumptions are made, such as a two-grid method, uniform time-line and constant coefficient PDE. The convergence estimates are then explored in a variety of settings, including common parabolic and hyperbolic spatial discretizations coupled with implicit Runge-Kutta time-stepping schemes. Overall, the convergence estimates are sharp when compared to numerical experiments and are good predictors of multilevel results.