“Multigrid for space-time discontinuous Galerkin methods for advection dominated flows”

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Abstract

Space-time discontinuous Galerkin methods are excellent methods to approximate solutions of partial differential equations describing advection dominated flows on time-dependent domains: the space-time DG method, for example, automatically satisfies the geometric conservation law (a uniform flow field is preserved on dynamic meshes), is locally conservative, can handle discontinuities in the solution and $p$-adaptation is trivial. Unfortunately, like many other discontinuous Galerkin methods with implicit time-stepping, solving the discrete system is expensive.

In this talk I will discuss our work on the development of multigrid methods for space-time DG discretizations of advection dominated flows. In particular, I will introduce our $hp$-MGS multigrid method that combines $h$- and $p$-multigrid, semi-coarsening, and Runge-Kutta smoothers. I will discuss the multilevel analysis we performed to optimize the Runge-Kutta smoothers and present results of numerical simulations to show the performance of the $hp$-MGS algorithm on a number of test cases, including thin boundary layers and non-constant coefficients.