LA SERENA NUMÉRICA I
Sexto Encuentro de Análisis Numérico de Ecuaciones Diferenciales Parciales
Departamento de Matemáticas, Universidad de La Serena, Diciembre 14–16, 2011

Hybrid discontinuous Galerkin methods for the Navier-Stokes equations

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Abstract

Discontinuous Galerkin finite element methods provide a lot of freedom to obtain desired stability properties of numerical schemes. In particular, the upwind choice of numerical fluxes allow large convective terms, e.g. large Reynolds numbers. Furthermore, by relaxing the continuity constraints of the finite element basis functions it becomes simple to construct exactly divergence free discrete approximations leading to stability in kinetic energy.

Discontinuous Galerkin methods lead to an increased number of unknowns, and even worse, to a much stronger coupling in the stiffness matrix. Here, recent hybridization techniques come into the game. One introduces even more unknowns on element interfaces. But now, the coupling between elements is reduced to the interface variables, and the element unknowns can be eliminated by static condensation.

In our talk we discuss the construction of such hybrid DG methods for the incompressible Navier-Stokes equations. We discuss the connection to time integration (in particular splitting methods), and iterative solvers (in particular domain decomposition methods). Numerical results for benchmark problems are presented.

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