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Symmetrizable first order formulation of Navier-Stokes equations and numerical results with the discontinuous Galerkin method

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In [1], it was remarked that the heat equation could be formulated as the 0-relaxation limit of a hyperbolic system with source term. This formulation is attractive for the following reasons: it gives a unified discretization of hyperbolic and diffusive terms; it may allow to get a high order representation of gradients [2]; it may allow to relax the stiffness of the advection-diffusion coupling [2]; it may allow to derive non reflecting boundary conditions [3].

The aim of this talk is first to propose an extension of Cattaneos formulation to general dissipative systems such as the compressible Navier-Stokes equations, and prove that the proposed first-order formulation is hyperbolic. The proposed first-order formulation is an alternative hyperbolic system approach to the continuum-based hyperbolic first-order system approach introduced in [4].

Then a discontinuous Galerkin discretization of the system is proposed, and the benefits of this method in terms of stiffness of the system and accurate representation of the fluxes compared to the classical Navier-Stokes approach are discussed.

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