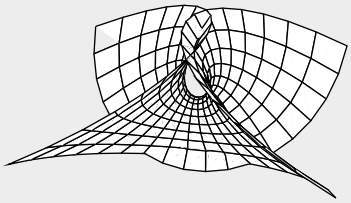

Oberseminar Mathematische Strömungsmechanik

Institut für Mathematik der Julius-Maximilians-Universität Würzburg

Hyperbolic equations - structure preserving methods & other topics

Walter Boscheri

University of Ferrara, Italy

High order schemes for the 3D Navier-Stokes equations at all Mach numbers

Abstract:

In this talk we present a high order pressure-based solver for the solution of the 3D compressible Navier-Stokes system at all Mach numbers. We propose a cell-centered discretization of the governing equations that splits the fluxes into a fast and a slow scale part, that are treated implicitly and explicitly, respectively. First, a second order space-time algorithm is devised, where pressure and viscous terms are discretized implicitly, requiring the solution of two nested iterative solvers. Next, a novel semi-implicit discretization is proposed for the kinetic energy as well as the enthalpy fluxes in the energy equation, hence avoiding any need of iterative solvers. The implicit discretization yields an elliptic equation on the pressure that can be solved for both ideal gas and general equation of state (EOS). High order in time is granted by implicit-explicit (IMEX) time stepping, whereas a novel CWENO technique efficiently implemented in a dimension-by-dimension manner is developed for achieving high order in space for the discretization of explicit convective and viscous fluxes. A quadrature-free finite volume solver is then derived for the high order approximation of numerical fluxes. Central schemes with no dissipation of suitable order of accuracy are finally employed for the numerical approximation of the implicit terms. Consequently, the CFL-type stability condition on the maximum admissible time step is based only on the fluid velocity and not on the sound speed, so that the novel schemes work uniformly for all Mach numbers. Convergence and robustness of the proposed method are assessed through a wide set of benchmark problems involving low and high Mach number regimes, as well as inviscid and viscous flows.

via Zoom video conference (request the Zoom link from klingen@mathematik.uni-wuerzburg.de)

Friday, Nov. 19 at 3 pm CET

Zu diesem Vortrag sind Sie herzlich eingeladen.

gez. Christian Klingenberg