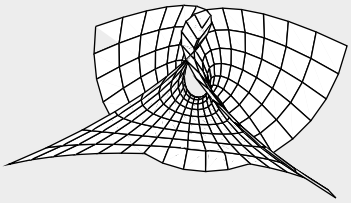

Oberseminar Mathematische Strömungsmechanik

Institut für Mathematik der Julius-Maximilians-Universität Würzburg

Hyperbolic equations - structure preserving methods & other topics

Claus-Dieter Munz

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Sharp interface modelling of phase change in two-phase flow

Abstract:

The numerical modelling of evaporation in a two-phase fluid is difficult within a continuum description because the equation of state is non- convex in the spinodal region. Approximating the phase transition as a discontinuity in a macroscopic description allows to introduce an additional wave - an evaporation wave –where appropriate jump conditions hold. The structure of the Riemann problem solution is preserved though we have four waves with three equations. By imposing jump conditions that satisfy a so-called kinetic relation, taking into account local thermodynamics and heat conduction at the interface, the non-physical states in the spinodal region can be avoided and a proper solution can be determined.

We apply this two-phase Riemann solution as well as an approximate two- phase Riemann solver within a sharp interface approximation based on a ghost fluid approach. We compare simulations for benchmark Riemann problems with phase change with results from molecular dynamics. A truncated and shifted Lennard-Jones potential in molecular dynamics allows long time and large space scale simulations to approach the macroscopic scales. A highly accurate deduced equation of state for the Euler equations establishes a one-to-one correspondence of the molecular dynamics and the continuum solutions.

References

T. Hitz, M. Heinen, J. Vrabec, C.-D. Munz: Comparison of Macro- and Microscopic Solutions of the Riemann Problem I. Supercritical Shock Tube and Expansion into Vacuum, J. Comput. Phys. 402 (2020)

T. Hitz, S. Jöns, M. Heinen, J. Vrabec, C.-D. Munz: Comparison of Macro- and Microscopic Solutions of the Riemann Problem II. Two-phase Shock Tube, J. Comput. Phys. 429 (2021)

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

Friday, May 14 at 3 pm CET

Zu diesem Vortrag sind Sie herzlich eingeladen.

gez. Christian Klingenberg