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08/05/2014

E I N L A D U N G

zu einem Vortrag im Rahmen des

Kolloquiums Thermo- und Fluiddynamik

Datum: **Mittwoch, 11. Juni 2014**

Zeit: **16:15 Uhr**

Ort: Maschinenlaboratorium ETH Zürich
Hörsaal ML H 44

Referent: **Prof. Bernhard Müller**
Department of Energy and Process Engineering
Norwegian University of Science and Technology, Trondheim, Norway

Titel: **Mach-Uniform Methods for Multiphase Flow Simulation**

The numerical simulation of multiphase flow has important applications in science and industry. In liquid-gas examples like in cavitation, the flow can vary from almost incompressible to supersonic. Computing multiphase flow over such a large range of Mach numbers challenges the accuracy and efficiency of the numerical methods. For single phase flow, pressure-correction methods have proved successful for incompressible flow, while approximate Riemann solvers have frequently been used for the inviscid flux approximation in compressible flow. The extension of pressure-correction methods to compressible flow with shocks and the preconditioning of approximate Riemann solvers for low Mach numbers have led to Mach-uniform methods, which can compute single phase flow at potentially all speeds.

In the presentation, an asymptotic analysis of the compressible Navier-Stokes equations for low Mach numbers will illustrate the fundamental change of a hyperbolic-parabolic system into an elliptic-parabolic system in the zero Mach number limit [1]. The analysis indicates how to extend pressure-correction methods from incompressible to compressible flow [2]. The idea of low Mach number preconditioning of typical compressible flow solvers based on approximate Riemann solvers will be outlined [3]. Finite volume methods on staggered and collocated grids, time discretizations and boundary conditions will be discussed for Mach-uniform methods.

The extension of Mach-uniform pressure- and density-based methods from single-phase to one- and two-fluid multiphase models will be presented [4, 5]. Strengths and limitations of current Mach-uniform methods for single and multiphase flow will be identified.

[1] B. Müller, Low Mach number asymptotics of the Navier-Stokes equations and numerical implications, 30th Computational Fluid Dynamics Lecture Series, von Karman Institute for Fluid Dynamics, 8-12 March 1999, http://folk.ntnu.no/bmuller/vki_ls_cfd_1999_1.pdf
[2] F. Cordier, P. Degond, A. Kumbaro. An asymptotic-preserving all-speed scheme for the Euler and Navier–Stokes equations, Journal of Computational Physics 231 (2012) 5685-5704
[3] E. Turkel, Preconditioning techniques in computational fluid dynamics, Annual Review of Fluid Mechanics 31 (1999) 385-416
[4] S.Y. Kadioglu, M. Sussman, S. Osher, J.P. Wright, M. Kang, A second order primitive preconditioner for solving all speed multi-phase flows, Journal of Computational Physics 209 (2005) 477–503
[5] S. LeMartelot, B. Nkonga, R. Saurel, Liquid and liquid–gas flows at all speeds, Journal of Computational Physics 255 (2013) 53–82

Host: Prof. L.Kleiser

Gäste sind willkommen!

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