Chair of Aerodynamics and Fluid Mechanics
Department of Mechanical Engineering
Technical University of Munich

Analysis of the Interfacial Mixing Properties of a Richtmyer-Meshkov Instability

Semester's Thesis, Master's Thesis

Contact: Josef Winter
Mail: josef.winter@tum.de
Phone: 089 289 16127
Start date: As of now

Motivation

Interfacial instabilities that can develop during the fluid-dynamic interaction between fluids are essential to a range of technical applications. The Richtmyer-Meshkov instability (RMI) develops when a perturbed interface between two fluids with different density is impulsively accelerated. An engineering application of the RMI is the enhancement of mixing processes. Recent numerical and experimental studies investigate the influence of the initial disturbance amplitude on the interfacial mixing properties. Previous studies at the chair of aerodynamics have shown that numerical simulations of the RMI using the in-house CFD solver ALPACA capture the relevant physical phenomena of the RMI.

Objectives

In the scope of this thesis the RMI developing at a V-shaped Air-Helium interface (see figure 1) shall be investigated and compared to experimental results [1]. After a suitable simulation setup is identified, the relation between the initial disturbance amplitude and the linear growth rate, an indicator for the interfacial mixing properties, should be investigated. The results can be compared to analytical models and experimental data.

Requirements

- Interest in multiphase flows and interfacial instabilities
- Knowledge of Unix based systems and the C++ or Python programming language is helpful, but not required

What you learn during this thesis

- Insights into the modeling of fluid interfaces and the simulation of interfacial instabilities in a state-of-the-art research CFD code
- Working on modern HPC computing systems of the Leibniz-Rechenzentrum (LRZ)

References

[1] Zhai, Z., Luo, X., and Dong, P. "The Richtmyer–Meshkov instability of a 'V' shaped air/helium interface subjected to a weak shock". In: *Theoretical and Applied Mechanics Letters* 6.5 (2016), pp. 226–229.

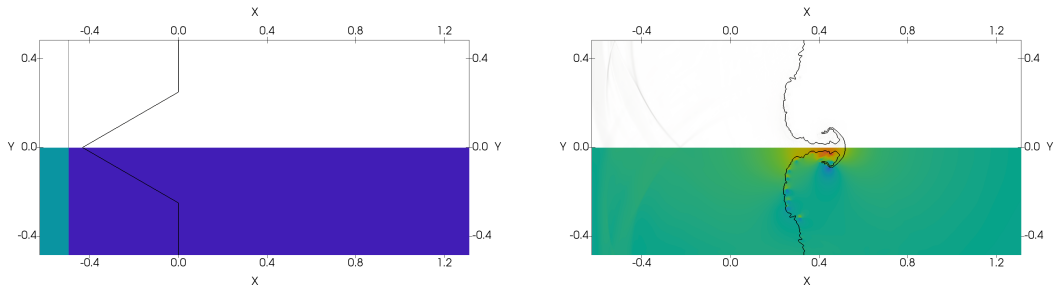

Figure 1: Richtmyer-Meshkov Instability developing at a V-shaped Air-Helium interface. Numerical schlieren are shown in the upper half. The lower half depicts the velocity. The initial configuration is shown on the left. The developed RMI at a later stage is shown on the right.