Chair of Aerodynamics
and Fluid Mechanics
Department of Mechanical Engineering

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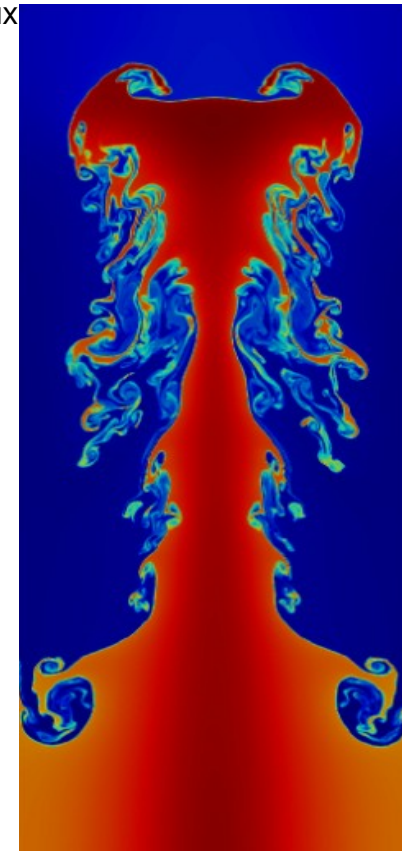
Performance-aware flexibilization of complex flow HPC solvers

The numerical simulation of compressible multi-phase flows containing sharp interfaces is of interest in many engineering applications. The interface physics can be well-captured by a level-set function. This approach, however, makes an efficient implementation of the solver challenging: Classical (well-optimized) stencil operations cannot be applied blindfolded because the respective fluid information is not present in all cells. Computing compressible flows, however, requires the usage of solvers built upon such stencils.

In this project, flexible stencil-based kernels of our multiresolution finite volume compressible flow solver ALPACA are to be developed. These kernels are supposed to work on arbitrary parts of the computation domain. Performance on modern HPC systems is a key aspect of the implementation. Hence, profiles have to be done on the LRZ Linux cluster. The programming language is C++17.



Tasks:

- Profiling baseline version of the kernel functions
- Design and implementation of improved versions
- Profiling optimized versions

Requirements:

- Knowledge of C++11
- Ability to work independently
- Knowledge of profiling software, beneficial
  Knowledge of approximate Riemann solvers, beneficial

Take-away:

- Insight into state-of-the-art research CFD code
- Improved C++ and object-oriented programming skills
- Experience with HPC-clusters
- Scientific working and writing
- Project management skills

Contact:
Nils Hoppe
Room MW1617
E-Mail nils.hoppe@tum.de
Phone 089/289-16336