Chair of Aerodynamics
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Department of Mechanical Engineering

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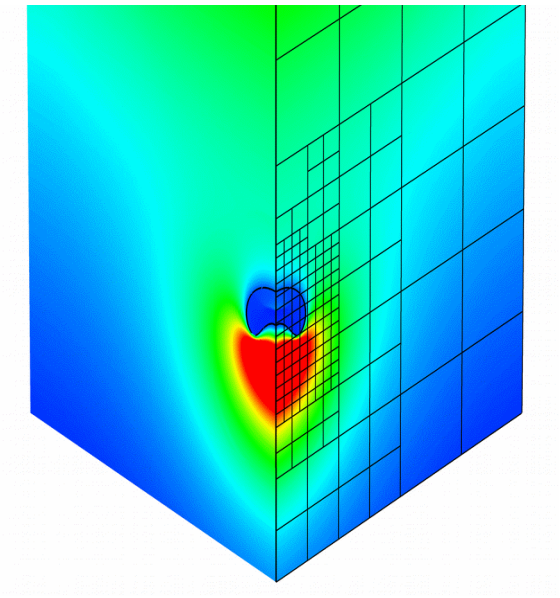
Improved MPI-topology for a multiresolution complex flow solver

The three-dimensional simulation of compressible multiphase flows with meaningful resolutions requires the usage of modern high performance computing (HPC) systems like the SuperMUC at LRZ. On such distributed-memory machines the compute domain needs to be split in order to compute on the subgrid in parallel. Typically, this is done via the Message Passing Interface (MPI), where each MPI-rank is assigned one or multiple of the subgrids. Obviously, information between neighboring subgrids needs to be exchanged. Therefore, ranks need to know which other ranks are in their neighborhood. A trivial approach is to provide the complete topology (which rank is in possession of which subgrid) to all ranks. This, however, requires slow and congesting all-to-all communication frequently. By saving only local topology information, such global MPI routines can be replaced by local ones.

In this project, the topology storage within each MPI-rank is to be redesigned such that it saves only local neighborhood relations. The concept for the neighbor storage is to be designed, implemented and analyzed for its parallel performance. Profiling will be done on the LRZ Linux cluster. The programming language is C++11.

Tasks:

- Design an implementation of local topology approach
- Profiling global and local topology version



Requirements:

- Knowledge of MPI
- Ability to work independently
- Knowledge of C++11, beneficial
- Knowledge of profiling software, 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

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