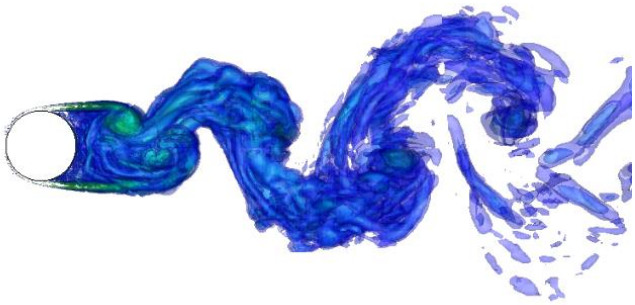
MASTER THESIS

Application of Scale Resolving Simulation Approaches for Training and Evaluation of Generative Machine Learning Methods

There is a growing consensus that the integration of machine learning (ML) techniques into existing modeling approaches will aid the solution of complex problems in science and engineering. To this aim, the Chair of Thermal Turbomachines and Aeroengines of the Ruhr-Universität Bochum collaborates with of the Stochastics Group at the Bergische Universität Wuppertal (Prof. Hanno Gottschalk) for the creation of physics-aided generative ML methods with the capability of generating complex turbulent fields. One fundamental test case of interest is the turbulent flow around a circular cylinder. For the training of the ML method, visual realizations of the turbulent field are needed whilst a statistical evaluation of the flow field is required for the verification of the ML method.

In this context, the thesis will focus on the scale resolving simulation (LES/DES) of a circular cylinder and the appropriate analysis needed for the training and evaluation of generative ML Methods. The computations are to be conducted with the Chair's in-house CFD solver SharC, which is capable of scale resolving computations with low-dissipation schemes and non-reflecting boundary conditions. Optionally, the results might me compared to a computation to be conducted with OpenFOAM.



The following tasks will be part of this project:

- Familiarization with the topic and the solver including a literature review.
- Preparation of the computation based on an existing mesh.
- Definition of the required post-processing data.
- Setup of an appropriate in-situ post-processing during run-time based on Paraview Catalyst.
- Computation on the High Performance Cluster of the Chair.
- Analysis and documentation of the results.
- Optional: Comparison to an incompressible computation in OpenFOAM.

The work will be carried out at the Chair of Thermal Turbomachines and Aeroengines of the Ruhr Universität Bochum. Working remotely is possible. Please hand in a complete application (English or German) including a CV, a cover letter (limited to one page), transcripts and contact details.

PREREQUISITES:

- Good knowledge of Fluid Dynamics and Mathematics;
- Interest in numerical methods, high-performance computing and scale resolving computations of turbulent flows.
- Ideally, basic knowledge of a programming language like python.
- Familiarity with the Linux OS.

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