Universität Rostock Traditio et Innovatio

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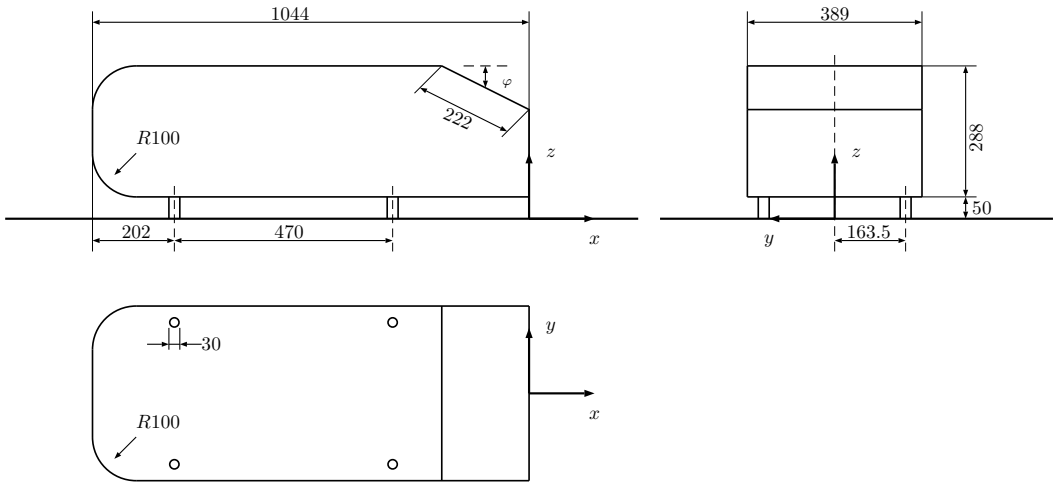
Master's thesis

CFD simulation of the aerodynamic flow over a bluff body in ground proximity using RANS modelling

Nowadays the prediction of external automobile aerodynamics using Computational Fluid Dynamics (CFD) is state of the art. Despite the fact that the continuously growing computational ressources allows even Large-eddy simulations (LES) for the prediction of road vehicle aerodynamics, simplified bluff body models are still essential as benchmarks for numerical simulations. The Ahmed body (introduced by the SAE International in 1984) is one of these bodies and is composed of a rounded front, straight mid-section and variable slant-rear section. This body exhibits many of the 3D flow structures exhibited by real passenger cars as counter-rotating longitudinal vortices and separation bubbles which increases the drag significantly.
The scope of this work is a detailed analysis of the applicability of the open source CFD toolbox OpenFOAM for the prediction of external automobile aerodynamics in steady-state RANS simulation with unstructured grids including up to 5×10^5 cells.

The following tasks have to be completed:

- Introduction into Linux and OpenFOAM
- Creation of a three-dimensional model of the Ahmed body for at least 4 different useful slant angles using an arbitrary CAD software
- Generation of unstructured grids with up to 5×10^5 cells using an arbitrary mesh generator (e.g. snappyHexMesh, enGrid)
- Investigation of the influence of the slant angle on drag and lift forces as well as the flow structures in the slant-rear section of the Ahmed body using Reynolds-averaged Navier–Stokes equations (RANS) in combination with the Spalart-Allmaras (SA) and k-ω-SST closure model
- Detailed analyis of the flow fields and structures around the Ahmed body using experimental measurements and different vortex identification criteria (e.g. λ_2 or Q criterion)
- Scientific summarization and detailed explanation of all numerical results within a master thesis written in LaTeX



Requirements: Good knowledge in C++ and fluid dynamics, first experience in Computational Fluid Dynamics (CFD)

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