TUM Hyperloop
TUM School of Engineering and Design
Technical University of Munich

CFD Study of Pressure Recycle Ducts as a Drag Reduction Method in Hyperloop

Type: Master Thesis
Content: theoretical / simulative
Possible start: April 2026
Key words: Aerodynamics, Drag Reduction Method, 3D simulation

TUM Hyperloop

Our group is researching Hyperloop technology for passenger transport. We focus on electromagnetic levitation, suspension, and propulsion, simulation of high-speed aerodynamic phenomena, cooling systems, and vehicle structure and infrastructure topics. Depending on the topic, we work on new test benches and the implementation of various experiments, computationally intensive simulations, or the design of new types of components. Our chair aims to motivate you and other students to develop modern technology for tomorrow – together as a strong team with the power of everyone.

Job Description

This thesis aims to expand the current understanding of pressure recycle ducts (PRDs) as a drag reduction strategy within the Hyperloop system. Building on existing work by the team, in which a single PRD configuration has been simulated, the primary objective is to investigate the impact of PRDs across different Hyperloop aerodynamic regimes and to develop improved designs that maximise their effectiveness while considering track constraints and the impact on the pod.

Your Tasks

- Research and understanding of Hyperloop aerodynamics, with a focus on pressure recycle ducts (PRDs) and track design.
- Improvement of the current 3D pod design and CFD setup.
- Simulation of a baseline case to identify the main aerodynamic trends and flow phenomena.
- Development of new geometries and parametric CFD studies of the proposed designs for different system parameters.
- Definition of an operational regime based on a self-derived cost-function.
- Analysis of results and formulation of design recommendations for PRD implementation, including comparison with previous drag-reduction studies conducted by the team and with single-pod simulations, as well as the derivation of an artificial blockage ratio quantity.
- Strong teamwork skills and willingness to collaborate in a multidisciplinary environment. Regular on-site presence in our office, in Ottobrunn, is required.

Our Requirements

- Good knowledge of Fluid Mechanics and Aerodynamics.
- Critical thinking with a precise and detail-oriented work style.
- Reliable and consistent in delivering on agreed tasks and responsibilities.
- Good knowledge of CAD, ANSYS Fluent, Python and/or MATLAB is a must.

Contact

If you are interested in working with our team, please send your CV, grade report, motivational letter, and supporting documentation to João Nicolau (joao.mp.nicolau@tum.de). If you have any questions, do not hesitate to contact us.