Universität
Stuttgart

**INSTITUT FÜR AERODYNAMIK
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Supercritical Hydrogen/Air Mixing with a Discontinuous Galerkin Spectral Element Scheme

Master Thesis

An alternative strategy to conventional internal combustion engines is their modification to use hydrogen as a fuel. To maintain an efficient combustion process, a profound understanding of the injection of hydrogen into the combustion chamber is of utmost importance. The injection, necessarily at high nozzle pressure ratios to attain suitable mass flow rates, is dominated by an under-expanded jet developing from the nozzle exit.
In this thesis, the capability of the high-order discontinuous Galerkin framework *FLEXI* is investigated to simulate the injection of hydrogen into air. Of special interest is the effect of key features from the numerical discretization (mesh, split-DG, double-flux method) on the thermodynamic mixing process.

Work Packages

- Literature study: under-expanded jet mixing, real gas EOS, double-flux, split-flux DG
- Simulation of the Okong'o shear layer [1] with ideal and real gas EOS
- Quantification of influences on the mixing process and comparison to the literature
- Simulation of a high pressure hydrogen injection [2]

Prerequisites:

- Basic knowledge in Linux and Fortran
- Experience in console-based CFD simulations and principal understanding of numerical methods for PDEs
- Self-reliant, interest in numerical algorithms and multicomponent thermodynamics

Literatur

[1] Okong'o, Nora, Harstad, Kenneth and Bellan, Josette. Direct numerical simulations of O/H temporal mixing layers under supercritical conditions. *AIAA journal* 40.5 (2002): 914-926.

[2] Hamzehloo, Arash and Aleiferis, Pavlos. Large Eddy Simulation of Near-Nozzle Shock Structure and Mixing Characteristics of Hydrogen Jets for Direct-Injection Spark-Ignition Engines. *International Conference on Heat Transfer, Fluid Mechanics and Thermodynamics* (2014).

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Starting Date: as soon as possible

Auf das "Merkblatt für die Anfertigung von Bachelor- und Masterarbeiten" wird hingewiesen.