Universität Stuttgart
Institut für Reaktive Strömungen

Bachelor or Master Thesis

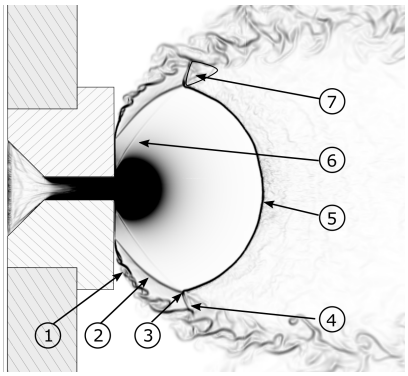
Simulation of a Rocket Engine Injection under Flashing Conditions

Motivation

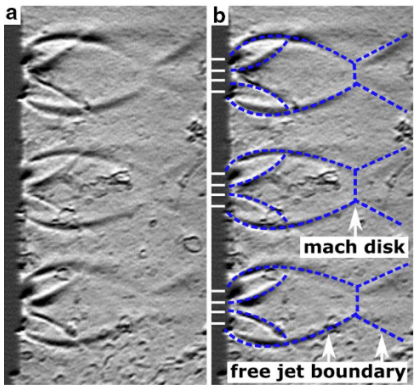
The recent rapid development of international space transportation demands novel, lightweight rocket engines with restart capabilities, while fulfilling current environmental regulations. The combination of combustion of cryogenic propellants with laser ignition is a promising solution. However, prior to ignition the cryogenic liquids are injected into conditions far below their saturation pressure leading to immediate boiling, so called flash evaporation. The flow field and processes at the injector exit and face plate are not yet fully understood and further research is required.

Project description and research goals

Within the Sonderforschungsbereich Transregio 75, a compressible, single-component, two-phase solver has been developed in the CFD framework OpenFOAM. This solver shall now be applied to realistic rocket engine injectors, which were experimentally investigated at the DLR Lampoldshausen. In the first step, the solver's capability to inject pure fuel or oxidizer is validated. In a subsequent step, the combined injection is tested, and interactions between injectors as well as the flow field at the face plate shall be studied to identify suitable locations for laser ignition.



(a) Density gradient of flashing LN2, LES simulation.



(b) Time-averaged Schlieren image of pure hydrogen injection (Börner et al. 2017)

Tasks

- Do a literature review to learn about flashing sprays and numerical simulations with OpenFOAM
- Simulate the injection of the gaseous hydrogen and cryogenic LOX separately
- Simulate combined injection of LOX and hydrogen
- Evaluate and analyze the simulation results
- Write a thesis and present your results

Prerequisites

- Basic knowledge in fluid dynamics, programming with Matlab, Python or similar
- Beneficial: knowledge in C/C++, experience with computational fluid dynamics (CFD), OpenFOAM

Contact

If you are interested, feel free to contact:

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