Professur für
Thermofluiddynamik

Master Thesis

Start: As soon as possible

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☒ theoretical
☒ numerical
☐ experimental
☐ constructional

Simulation of Hydrogen Flames Through Tabulated Chemistry

The usage of hydrogen as an alternative, zero-carbon fuel is a very promising field of research for both energy and transportation sectors. Hydrogen flames also offer great modeling challenges, due to their high burning velocities, fast chemical time scales, and particularly their complex molecular diffusivity making them susceptible to thermodiffusive instability.

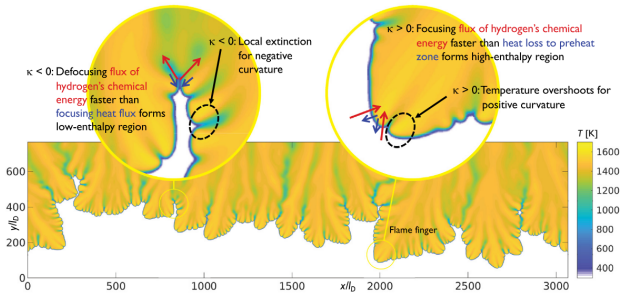

Figure 1: Structure of a 2D H_2-Air flame. Taken from Pitsch, H., Proceedings of the Combustion Institute, Volume 40, Issues 1–4, 2024.

The simulation of a hydrogen flame through CFD can involve the utilization of a Flamelet Generated Manifold (FGM) method, tabulating the reaction rate as a function of a few control variables representing the chemical state, such as mixture fractions and progress variable. In contrast, species transport (finite rate chemistry) models are based on the computation of chemical source terms based on the local concentrations of each species of interest which have to be transported in the CFD solver.

In this thesis, the student is tasked with employing different chemistry models available in a commercial CFD software, applying them to a laminar hydrogen flame and comparing the results with experiments, as well as detailed chemistry. The different methods will be appraised based on their accuracy and cost.

Requirements:

Good knowledge of Fluid Dynamics
Interest in Combustion and CFD
High motivation to learn new concepts

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