Master thesis

Experimental investigations of turbulent ammonia/hydrogen flames using laser diagnostics

Experimentelle Untersuchungen von Ammoniak/Wasserstoff-Flammen mit Hilfe der Laserdiagnostik

Motivation

Reducing the carbon footprint in the energy sector has become a key challenge of this century that requires global collaborative efforts. Chemical storage of renewable energy, such as wind and solar, followed by thermochemical conversion for energy utilization, is an important pathway to ensure a smooth transition to a carbon-neutral economy. In the future energy mix, hydrogen (H_2) will be widely used as a clean fuel, and its combustion characteristics require extensive investigations, especially under lean and turbulent conditions, which is important for gas turbine applications.

Objectives

In this work, the turbulent flame and flow field structures of NH_3/H_2 mixtures will be experimentally measured under turbulent conditions. The existing multi-regime burner (MRB), a special design for investigating the transition of premixed and non-premixed combustion, will be used to stabilize turbulent NH_3/H_2 flames. In the first step, constructive improvements should be performed on the MRB burner and operation conditions will be determined based on fuel mixture and laminar flame properties from simple 1D flame calculations in Cantera. To study the turbulence-flame interactions, the flame reaction zone will be measured by planar laser-induced fluorescence of OH radicals (OH-PLIF). From the OH-PLIF images, the curvature and flame surface density of the reactive flame front can be statistically determined. Simultaneously, the flow field will be determined by particle image velocimetry (PIV) or particle tracking velocimetry (PTV) measurements. By combining PIV with OH-PLIF, the local strain rates and their impact on the flame front topology could be analyzed.

Tasks:

- Review the literature, especially on the relevant topics of H_2 and NH_3 combustion
- Adaption of the existing MRB burner for NH_3/H_2 blends
- Determination of operation conditions for NH_3/H_2 flames
- OH-LIF and PIV measurements and data evaluation
- Intermediate and final presentations, writing final theses

Requirements:

- Interest in lab work
- Knowledge in Siemens NX, Labview, and Matlab is preferred

Are you interested?

Feel free to contact me!

(This work can be conducted either in English or German)

Reaktive Strömungen und Messtechnik (RSM)

Reactive Flows and Diagnostics

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