Research Assistant (PhD candidate) in the field of clean combustion of sustainable fuels

Description

The Institute of Combustion Technology for Aerospace Engineering (IVLR) at the University of Stuttgart offers an exciting job opening with the opportunity to conduct a PhD in the field of turbulent reacting multi-phase flows with focus on the emission formation process of net carbon-free fuels in highly turbulent gaseous flows.

Focus Area

Experimental investigation of NOx emission and particulates prevention of carbon-neutral fuels in highly turbulent flows

Background

The institute of combustion technology for aerospace engineering (IVLR) at the University of Stuttgart is an integrative unit of the DLR institute of combustion technology. The institutes host approximately 80 scientists plus a number of students from various fields of specialization to address research question of modern gas turbines. Thermal conversion of sustainable energy carriers, e.g. green hydrogen or ammonia, is a key element for the energy transition policy, while synthetic aviation fuels are without alternative for flights beyond mid-range distances. We support this development with the competence fields computer simulation, chemical kinetics and analytics, combustion diagnostics, mass spectrometry, multi-phase flow and high-pressure combustion. Current research topics are instationary combustion, pollutant formation, spray combustion, alternative fuels and innovative combustor systems. In this context, we target fundamental research and transfer the results to technical applications.

Your position is assigned to a DFG funded junior research group at the IVLR, University of Stuttgart, work in close cooperation with the DLR Institute combustion technology and advance the fundamental understanding of turbulent reacting multi-phase flows and emission prevention methods to enable technology innovations. For this purpose, we utilise canonical spray, combustion and flow reactor configurations as well as realistic high-pressure test rigs. We employ additive manufacturing to incorporate form follows function design capabilities in order to optimise fuel injection and mixture homogenisation. Laser-based diagnostics and novel data analysis methodologies are our most important tools to resolve the effects of turbulent flow on physical and chemical processes governing in fuel injection, mixture formation, combustion and emission formation. The acquired highly accurate data are used to advance our fundamental understanding of the involved processes, allow us to develop novel and optimised fuel injector and combustors concepts as well as validate and advance numerical models.

Problem Definition

The overarching objective is the advancement of fundamental understanding of the interactions between turbulent flow, reaction chemistry and multiple phases that govern pollutant formation as well as fuel and load flexibility of combustion concepts. The acquired understanding is of paramount importance for the development of cleaner, more sustainable and environmentally friendly technologies. In order to achieve close-to emission-free operation and reduce the overall climate impact, the thermochemical conversion of carbon-neutral fuels must further prevent the formation of secondary emissions. In this context, auto-ignition based combustion (e.g. MILD, FLOX, flameless oxidation) concepts are particularly promising due to the excellent fuel flexibility and reduced tendency to form NOx emissions and particulates. For example, the latter exhibits a significant impact on climate change in the aviation sector via non-CO_2 effects due to the initiation of contrails. However, the sought flexibility and low emissions are impeded due to the lack of multi-fuel suitable injection and mixing concepts. Spatially distributed micro injection and mixing, realisable by novel additive manufacturing capabilities, offers a promising methodology to achieve these objectives. Yet, the inherent complexity of the involved nonlinearities and multilateral interactions on multiple scales is accompanied by a lack of quantitative data. This gap shall be closed using integrated sensors and sampling ports (enabled via additive manufacturing) as well as laser-based diagnostics in combination with a novel AI-supported data analysis concept. Your specific tasks will involve:

- Familiarise yourself with the topics turbulent reacting multi-phase flows of sustainable fuels.
- Conduct CFD-assisted design for an AM enabled geometry optimisation.
- In the team we will develop novel laser-based diagnostics to delineate the involved processes and interactions.
- Plan and conduct detailed measurements of turbulent reacting flows, i.e. from flow through porous media, fuel injection and mixing, combustion and emission formation.
- Advance innovative fuel injection and mixing concepts.
- In the team we develop innovate data analysis tools to enable a quantitative description of the studied phenomena and interactions via the incorporation of machine learning methods.
- You analyse the data and present your work within the team, on national and international conferences as well as journal publications.
- Your results will provide the fundamental understanding to develop novel injector concepts, to enhance fuel and load flexibility as well as scalability limits and reduce pollutants.
- You engage and discuss your findings with various internal and external colleagues as well as national and international collaboration partners.

Your Qualifications

- Completed academic university degree (MSc. / university diploma), e.g. in aerospace engineering, engineering, physical chemistry or comparable subject
- Determination, commitment and enthusiasm
- Innovation capability, open mindedness and good comprehension
- Independence and team work within and outside our group
- Strong background in fluid mechanics and thermodynamics
- Basic knowledge of experimental and numerical turbulent reacting flows investigations
- Experience with programming languages (e.g. Python) is advantageous
- Experience with CAD and laser-based diagnostic is desirable
- Fluent in written and spoken English
- Knowledge of the German language or interest to learn the language is beneficial

We offer

- Excellent opportunity to conduct a PhD (fully funded TV-L EG 13, 100%)
- You will be part of a young and highly motivated team that is an integrative subdivision of a very experienced and interdisciplinary research department
- Focus on fundamental research with a simultaneous high exposure to technical application within the department
- Collaboration with leading national and international research labs
- Interdisciplinary, independent and diversified research tasks
- A stepping stone for a leadership career in industry and research
- Possibility to participate in national and international conferences and workshops
- Access to an extensive profession development programme

Application

If you are interested, please send your application documents (or questions) via email to Fabian.hampp@ivlr.uni-stuttgart.de by latest the 04.06.2023. A complete application should consist of: Cover letter (1 page), academic CV, certificates, research interests and hypothesis for the PhD (max. 1 page), ideally 1-2 references and other potentially relevant documents.

Basic information

Type of employment: full-time

Starting Date: earliest possible 01.10.2023

Remuneration: TV-L EG13, 100% (Entgelttabelle TV-L 2023)

Application Deadline 04.06.23 – 23:59

The University of Stuttgart would like to increase the number of women in the scientific field and is therefore particularly interested in applications from women. Severely disabled persons are given priority in the case of equal suitability. The employment process of scientific employees is carried out by the university's central administration.

Contact Details

University

University of Stuttgart

Institute

Institute of Combustion Technology for Aerospace Engineering (IVLR)

Location

Pfaffenwaldring 38-40

70569 Stuttgart, Deutschland

Contact Person

Dr. Fabian Hampp

E-Mail

Fabian.hampp@ivlr.uni-stuttgart.de

Website

Institute of Combustion Technology for Aerospace Engineering (IVLR) | University of Stuttgart (uni-stuttgart.de)

DLR - Institute of Combustion Technology - Home