



Research Associate (Postdoc)

Description

Research at the Institute for Combustion Technology at the University of Stuttgart focuses on theory and computation of turbulent multiphase flows. The key expertise of our work is the modelling of multiscale processes and the corresponding interactions between turbulence, chemistry and particle dynamics. Examples include specific combustion related issues like turbulent combustion, solid fuel combustion and pollutant formation but also nanoparticle flame synthesis, flash boiling and mixing in particle laden flows.

The key challenges are associated with scale separation, i.e. even high-fidelity simulations using massive computing resource cannot resolve all physical and chemical length and time scales. We therefore use detailed simulations of reduced computational domains to aid the development of deterministic and stochastic models that can then account for all small-scale phenomena that will not be resolved in computations that cover the large scales including the burner dimensions. The ever-increasing computer power now provides huge databases that can be exploited using machine learning techniques to extract novel information and to provide new models in the form of trained network libraries. The focus of the advertised position is on the continued development of machine learning methodologies for an improved and more efficient use as closure models for sub-grid interactions between particles, gas phase, chemistry and turbulence.

Your tasks:

- The development of algorithms based on methods related to deep learning approaches for the use in the fields of turbulent combustion and nanoparticle flame synthesis.
- In the field of turbulent combustion, complex chemical mechanisms for solid fuel combustion and pollutant formation (soot) shall be reduced and/or efficiently be replaced by trained neural networks
- A further research topic within the area of turbulent combustion is the so-called super-resolution that generates - with the aid of machine learning techniques - highly resolved fields from low resolution solutions. This can yield novel closure strategies for large-eddy simulations (LES) or RANS.
- In the area of nanoparticle flame synthesis, key characteristics for particle dynamics in turbulent advective flows need to be defined and models for collision frequencies need to be derived.

- Characteristic quantities for hetero-aggregates shall be derived from detailed Langevin simulations and the dynamics of aggregation shall be modelled as function of a multidimensional space.
- Additional databases need to be generated using ITV's in-house version of OpenFOAM.
- New machine learning techniques shall be developed for a more efficient coupling of the ML derived models/libraries with standard solvers.

Your profile

We expect an excellent Master's degree in engineering or related disciplines. Your PhD must have focused on the development and application of machine learning techniques to combustion processes or – more generally – to topics related to turbulent, reacting multiphase flows. You enjoy theory and model development and their numerical implementation. You will have experience in programming (C, C++, Python) and usage of ML related software such as TensorFlow. Knowledge of OpenFOAM for data generation would be beneficial.

You will be an enthusiastic and self-motivated person with a willingness to work closely with other team members. The Institute's scientific language is English, but willingness to study German is expected.

We offer:

- The pay scale is according to TVL-E13. The grade and therefore the final salary will depend on your relevant experience. The original appointment will be for one year. Upon successful completion of the first year, the employment may be extended for two further years.
- We offer excellent potential for scientific development in the Institute for Combustion Technology (ITV) at the University of Stuttgart with state-of-the-art computer facilities and access to the University's supercomputing centre.

The University of Stuttgart is one of the leading technically oriented universities in Germany with about 26.000 students and more than 5.000 staff. The Institute for Combustion Technology is part of the Faculty of Energy-, Process- and Bioengineering.

If interested, please send your CV and all other relevant application documents as PDF per email to bewerbungen@itv.uni-stuttgart.de

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