Universität Stuttgart
Institut für Reaktive Strömungen

Research Project

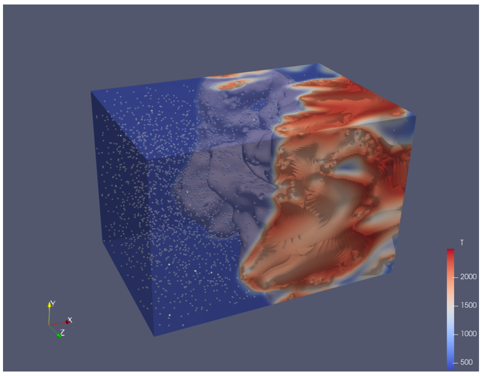
Improved Closures for Spray Combustion based on Deep-Learning Strategies

Motivation

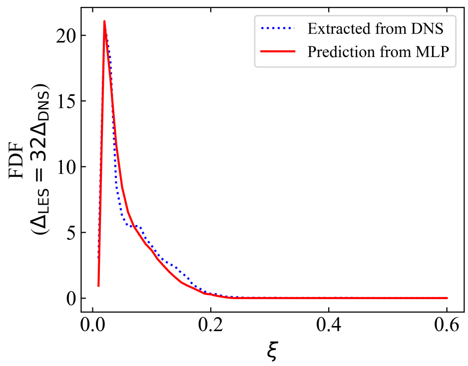
As an energy conversion approach, spray combustion is widely used in industrial furnaces and transportation systems. Increasingly stringent restriction on pollutant emissions has been demanding a deeper understanding of the combustion process. Computer simulation of spray combustion can provide insights into the dynamics of the combustion process and help to predict the performance of burners. However, accurate simulation of spray combustion remains a very challenging task because spray combustion is a highly complex process involving turbulence, atomisation, droplet evaporation and chemical reactions.

Project description and research goals

The project aims to improve the accuracy of spray combustion simulation by developing improved subgrid-scale models for Large-Eddy Simulation (LES). These models will be developed with the aid of Deep Learning. Direct Numerical Simulation (DNS) will be performed to provide a training database for Deep Learning and LES will be performed to validate the models. TensorFlow or other similar software for Machine Learning will be used to build the models. OpenFOAM will be used for DNS and LES.



(a) CP-DNS of turbulent spray flames.



(b) A priori validation of a Multilayer Perceptron model.

Possible works for Bachelor/Master students

- Parametric study of artificial neural networks (ANNs)
- To be determined ...

Prerequisites for Bachelor/Master projects

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

Contact

If you are interested, feel free to contact:
Ruyue Cheng
(https://www.irst.uni-stuttgart.de/institut/team/Cheng-00008/)
☎ +49 711 685 67456
✉ ruyue.cheng@irst.uni-stuttgart.de

More information and other available topics: https://www.irst.uni-stuttgart.de/