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Stand: 01.12.2021

Studien- / Bachelor- / Masterarbeit / HiWi

Scaling Analysis of Inert Sprays in the Context of Compression Ignition Engines

Reduction of harmful greenhouse gas emissions from the transportation sector is paramount to achieving global net-zero emission goals. One of the pathways to the goal is novel bio-hybrid liquid fuels from renewable energy and carbon sources, which can be a major form of carbon-neutral energy for future propulsion systems due to their high energy density. Since fuel is delivered to an engine in the form of a spray, a fundamental understanding of the spray and mixing performance of the new fuel candidates in the engine is necessary to design and develop the fuels for advanced combustion concepts. In this context, a fast, reduced-order model for inert sprays has been developed based on the cross-sectionally averaged spray (CAS) model [1,2]. Building on this previous work, a scaling analysis of spray formation should be carried out with respect to relevant non-dimensional parameters, such as Reynolds number, Weber number, Density ratio, and so on. This scaling analysis is expected to contribute to the understanding of underlying spray formation processes, such as breakup, evaporation, and mixing.

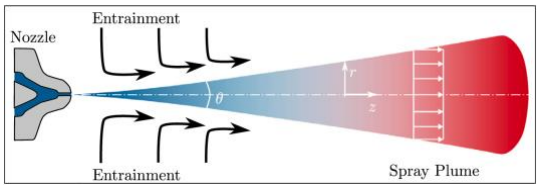

Fig. 1: Schematic of spray plume.

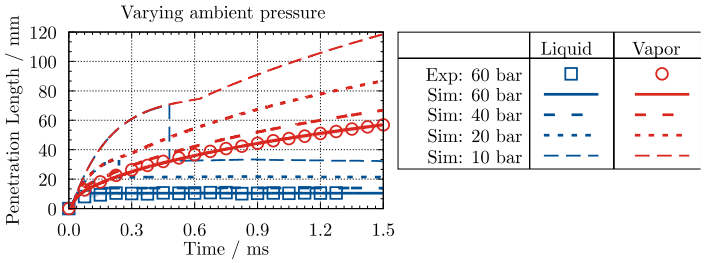

Fig. 2: Effect of ambient density on the spray penetration.

Tasks

- Derivation of non-dimensional (ND) form of CAS model
- Implementation of the ND CAS model in the inhouse code CARTS
- Running ND parameter variations
- Analysis of results and writing

Prerequisites/Requirements

- Programming knowledge, preferably Fortran
- Multiphase Flows class is desirable
- Self-motivation and commitment

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**** There is a possibility to combine thesis work with HiWi**

References

[1] Y.P. Wan, Numerical Study of Transient Fuel Sprays with Autoignition and Combustion under Diesel-Engine Relevant Conditions (Ph.D. thesis), RWTH Aachen University (1997).
[2] A. Y. Deshmukh et al., A reduced-order model for multiphase simulation of transient inert sprays in the context of compression ignition engines. Int. J. Multiph. Flow, vol. 147, pp. 103872, 2022.