Master's- or Bachelor's Thesis

Development of a digital twin for combustion experiments (Computer Science/Engineering/Physics)

Idea:

Combustion is a complex process that depends on a variety of different parameters. Even here on earth we have not fully understood how fire spreads in a real scenario. In a spaceship, under reduced gravity, it is even more important to assess and understand the risk of a fire outbreak. We are gathering data by conducting combustion experiments under controlled conditions. But what if the attempt to control the conditions is influencing the result itself? For example, what is the influence of the size of the combustion chamber? Or the ignition method? To answer these (and many more) questions, we want you to develop a digital twin of our experimental setup. This model shall encompass all relevant measurements, process steps and experiment conditions. With the help of the model, the data from more than 100 drop tower experiments can be evaluated to (hopefully) uncover new, previously unnoticed, relationships in the data.

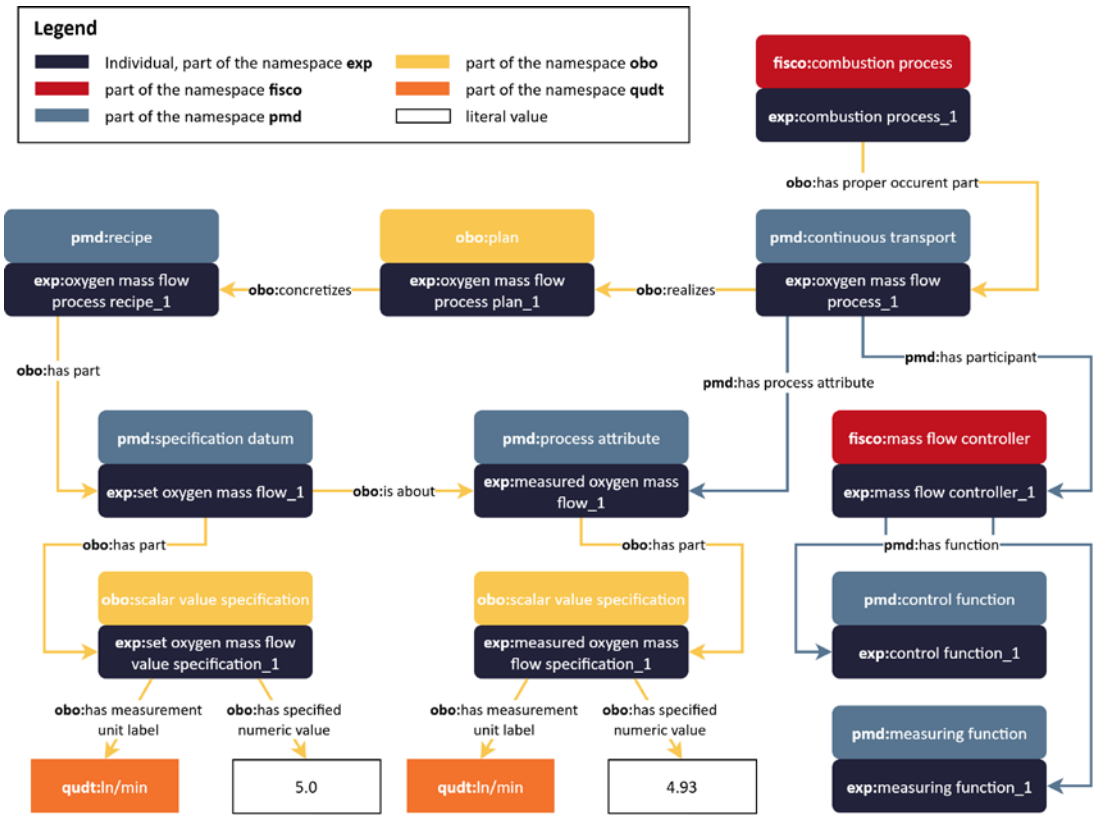

Fig. 1: Modelling of the forced air flow during a combustion experiment.

If you are interested, please contact:
Keno Krieger, Combustion Engineering
E-Mail: keno.krieger@zarm.uni-bremen.de

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Project description:

This thesis is part of the international FiSCO (Fire Safety Combustion Ontology) project. The final goal of the project is to combine the existing data from various experimental combustion setups to derive universally valid findings that are independent of the setup used. One big goal of the thesis would be to create a so-called ontology. An ontology is a tool to represent connections between all the parameters involved in an experiment (cf. Figure 1). For example, a measurement is no longer just a number with a unit. Instead it is connected to the device that was used to measured it and its place in the whole process chain. This so-called semantic representation helps humans and machines alike to understand the process. With the help of the ontology, one can create a database, optimize experimental procedures, or use machine learning to make new discoveries.

We are looking for students who:

- Enjoy working with data & data structures
- Like coding/modelling and dealing with abstract concepts
- Develop their own ideas for using a digital twin
- Basic knowledge of combustion/thermodynamics and physical processes

What we offer:

- Learning new methods and skills that will be relevant in the future
- Working on a project that can have real impact for modern research
- Connecting with experts in combustion, microgravity and data management
- Support during the development phase and during writing the thesis

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