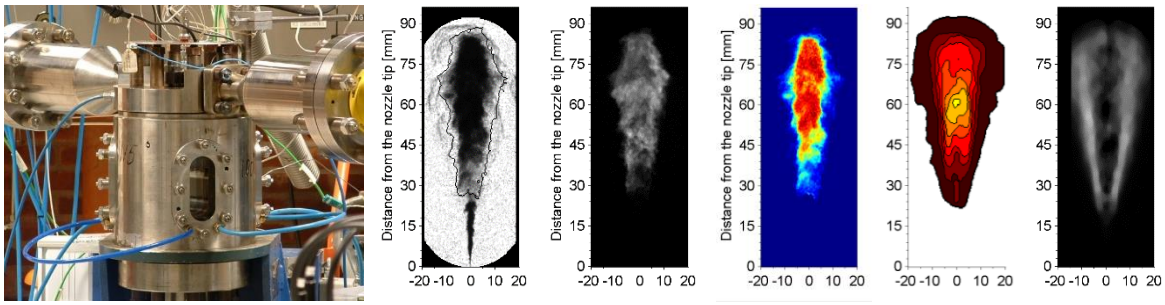
Master thesis project

Optical characterization of sprays from advanced fuel injection systems



Background: Efficient combustion in internal combustion engines requires an appropriate fuel-air mixing to ensure high efficiency and low emission formation. In Diesel engines the fuel is injected directly into the cylinder and self-ignites during the fuel injection. Liquid fuel (conventional or renewable) is pressurized to a very high pressure and injected through small nozzle holes resulting in the formation of a spray. In the spray, the liquid fuel is broken up into drops which evaporate and a combustible fuel-air mixture is formed. The same fuel injection system must function reliably and with high performance at all engine speed and load conditions, cold-start and hot operation, and with some variation in fuel properties. Thus, it is of great importance to understand how the spray formation, evaporation, mixing and combustion process is affected by various operational parameters. The most detailed spray characterization experiments are carried out in dedicated heated high-pressure spray chambers with windows for advanced optical diagnostics, applying lasers, high-sensitivity or high-speed cameras, for spectroscopy and imaging.

Project: This is an experimental project in which fuel sprays from an advanced fuel injector will be characterized in a specially designed spray and combustion chamber. In the chamber air pressure and temperature comparable to those inside an engine can be maintained, and the chamber has large windows to enable optical diagnostics. The sprays will be illuminated with lasers or other advanced light sources and imaged with high-speed video cameras (frame rates >100 000 per second). The distribution of liquid and vapor phase fuel will be characterized at various gas conditions and injection parameters, and the luminescence light emitted from the flame will be analyzed. The spray and flame properties will be characterized at various gas conditions and injection parameters. The project includes preparation of the experimental equipment, experiments in the spray chamber and analysis of the experimental data. The project is suitable for students with a background in mechanical engineering, physics, chemistry, chemical engineering or similar, and with a keen interest for experimental work.

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