

LASER-BASED IMAGING DIAGNOSTICS FOR IN-CYLINDER MEASUREMENTS IN INTERNAL COMBUSTION ENGINES

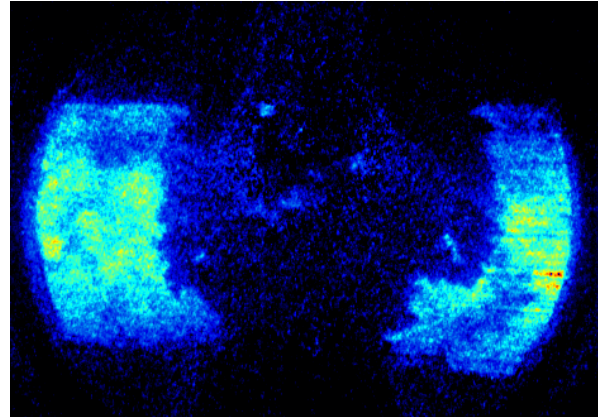
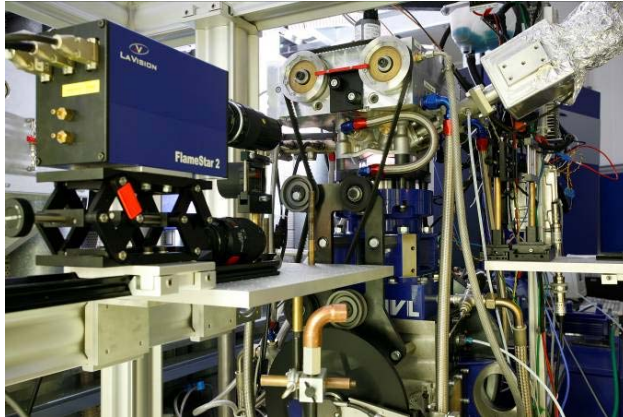


Figure 1: Optically-accessible internal combustion engine

Figure 2: CH₂O fluorescence during combustion

In modern internal combustion engine development for automotive applications, the reduction of pollutants (e.g. NO_x, unburned hydrocarbons, etc.), as well as the reduction of fuel consumption play an important role. Laser-based in-cylinder measurement techniques allow to analyze and to improve the combustion process.

One approach to gathering information about in-cylinder combustion and mixing of air and fuel is *laser-induced fluorescence (LIF) imaging* in an optically-accessible engine. The physical principle of this method is the electronic excitation molecules by laser light and the detection of the subsequent fluorescence by a highly sensitive camera. The detected species could either be introduced into the engine together with the fuel (e.g. toluene), or they are generated during the combustion process (e.g. CH₂O, OH). In most cases they are excited by a laser light sheet. With this method a plane within the engine is illuminated and the fluorescence signal is measured by a camera thus providing information about the local concentration within a cross-section in the engine cylinder.

Another approach is *particle image velocimetry (PIV)* which uses the scattering of laser light off very small particles to visualize and analyze the in cylinder flow field during engine operation from the displacement on two subsequent images.

Within the scope of this project, LIF measurements of toluene and PIV measurements under varying operation conditions should be performed on the optically-accessible engine of the IVG.

This work covers the following subtasks:

- Getting familiar with LIF and PIV measurement techniques and the optical engine
- Qualitative and quantitative measurements of toluene concentrations with LIF as well as measurements of the flow field with PIV and interpretation of the results
- Short documentation and presentation of the project work

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