Diesel Spray characterization with Schlieren-Mie Technique

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HIGHLIGHTS

- A Diesel Spray is visualized with a combination of Schlieren and Mie scattering at engine relevant conditions.
- Non-liquid and liquid fuel is recorded simultaneously.
- Only one camera is necessary, thus temporal and spatial correlation is given.
- High power light sources and high speed cameras allow recordings with 100 000 frames per second.
- Movement of structures indicate the flow-field within the spray.
- Signal separation is provided by a dichroic mirror.
- A self-developed Matlab code distracts the spray geometry from the images.

ABSTRACT

Mixture formation determines power, efficiency and emissions in direct injected (DI) Diesel engines. Fuel injection is an important part of this process. Hence, scientists are seeking for advanced measurement techniques to understand the complex spray formation and interaction with ambient gas. The improvement of basic techniques, like Mie and Schlieren, by new measurement equipment is often neglected. High Speed recordings of combined Schlieren and Mie measurements give insights in flow fields and qualitative fuel distribution. A Photron Fastcam SA-Z is used for recordings of 100 000 frames per second at a resolution of 408 x 384 pixels. Powerful light sources provide Schlieren and Mie illumination in two different wavelength (DLR licensed LED-Illuminator 532 nm and Cavilux HF 640 nm). Thus the signals can be separated and analyzed individually. While Mie signals can be easily distracted from the background by setting a proper threshold, a Matlab code was developed to determine the Spray in the Schlieren images. Exemplary the penetration of liquid and non-liquid fuel are plotted and compared to a common spray model by Arai.

Fig. 1 Example of a Schlieren Mie superposing image in a Diesel injection at 60 bars and 923 K nitrogen atmosphere