2-D spatial Distribution of droplets in a Diesel Spray by Means of Direct Photography with Super High Resolution

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Abstract

The techniques to catch the droplets in a spray are LDA, PDPA and ILIDS (Interferometric Laser Imaging for Droplet Size). The first and the second take only the spot information of a spray ant the last is applied only to a thin spray like a swirl type nozzle for a gas turbine. Consequently, it is impossible for these techniques to a dense diesel spray.

The authors proposed the lenses with large aperture applied the magnifying principle of a refracting telescope and an analogue film with large size (8 [in] x 10 [in]). They applied the system to a non-evaporating diesel spray. The system showed the high spatial resolution and it was possible to capture the droplets size over 10 [μm]. Its depth of field was almost the same as the thickness of the laser light of 0.2 [mm], thus, it was able to take a photography over the whole region of a diesel spray. As a result, the authors succeeded to measure droplets ranged from the spray periphery to at most 6 [mm] in the direction of the spray axis and to find the scale of vortices in a spray which generate accompanying its development. The facts did not captured by a magnified photograph taken by the telescope system presented by one of authors in 1970s. The system obtained droplets information ranged from the spray periphery to at most 2 [mm] in the direction of the spray axis and it was unable to catch the vortex structure.

This report shows the new developed photographing system with the shallower depth of field than that of the old system. The objective spray is a pilot spray which uses in an actual high-speed DI diesel engine for means of countermeasure against the sever rule of exhaust emission. The fuel was injected into a high pressure chamber where carbon dioxide is charged to elevate the ambient density. The ambient temperature was the room temperature. The droplets were taken on an analogue film with large size of 8 [in] in width and 10 [in] in height which was the same dimension as that mentioned above through the light source of Nd:YAG laser. As a consequence, the minimum diameter of droplets captured is only 5 [μm] and it is capable of taking a photograph even near the spray axis where the droplets density is pretty dense.

Key words: Diesel spray, Droplet, Photograph

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