Ultra-high speed PIV measurement for gasoline spray ejected from a multiple hole DI injector

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HIGHLIGHTS

• Near the nozzle exit, velocity field of the spray ejected from the DI injector could be obtained by time-resolved PIV by using the ultra-high speed camera.
• In the region from the nozzle exit to 4mm downstream, the axial velocity of the spray at 1.1kg/m³ of ambient gas density slightly increased with an increase of distance from the nozzle exit.
• The similarity of the normalized velocity distribution of the spray maintained even though distance from the nozzle was different.
• The normalized velocity distribution of the spray was similar to that of single phase jet.

ABSTRACT

In the DI gasoline injector, injection pressure of the fuel and the ambient gas density is strongly related to atomization process of the fuel, and the atomization of the fuel affects the mixture formation between the fuel and air. Therefore, it is necessary to understand the atomization process near the nozzle in order to consider strategy of a high thermal efficiency of a gasoline engine. In order to understand the atomization process of the gasoline spray, velocity measurement in a gasoline spray was needed. In this study, gasoline spray injected into the constant volume vessel was taken by the ultra-high-speed video camera. Velocity field of the gasoline spray was measured with time-resolved PIV. Figure 1 shows the maximum axial velocity distribution from the nozzle exit to z=40mm for various ambient gas densities and injection pressures. In the region from z=0mm to z=4mm, the axial velocity of the spray at $\rho_a=1.1$kg/m³ slightly increased with an increase of the axial distance. Figure 2 shows normalized velocity distribution in radial distance for various ambient gas densities. The similarity of the normalized velocity distribution of the spray maintained even though distance from the nozzle was changed. Moreover, the normalized velocity distribution of the spray was similar to that of single phase jet. Therefore, it suggested that feasibility for application of ultra-high speed PIV technique to measurement of velocity field near the nozzle exit was confirmed.

Figure 1 Comparison of mean velocity of axial component $\bar{v}$ for various ambient gas densities.

Figure 2 Normalized velocity distribution in radial distance vs. Goertler solution.