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A LIF-PIV investigation of turbulence induced by sprays¹ DENNIS VAN DER VOORT, NICO DAM, WILLEM VAN DE WATER, HERMAN CLERCX, Eindhoven University of Technology — During the breakup of a high-speed liquid jet, it drags along and mixes the air surrounding it, creating turbulence. This turbulence can, in turn, influence the dispersion of the droplets in the resulting spray. Very little is known about the small-scale characteristics of the ambient turbulent flow. This work investigated spray-induced turbulence using (gas-phase) laser-induced fluorescent tracer particle image velocimetry (LIF-PIV), which suppresses the strong light scattering of jet and droplets on the images. The results for both a heptane (h) and water (w) spray (135 m/s and 125 m/s respectively) show that the heptane spray generates stronger turbulence due to the difference in breakup between the two fluids. Using a large-eddy estimation, carefully compensating for the finite size of the PIV windows, the dissipation rate ϵ and the small-scale turbulence characteristics are estimated as $\epsilon_h = 190 \pm 25 \text{ m}^2\text{s}^{-3}$, $\epsilon_w = 120 \pm 30 \text{ m}^2\text{s}^{-3}$, $\text{Re}_{\lambda,h} = 380 \pm 40$, $\text{Re}_{\lambda,w} = 290 \pm 40$, $\eta_h = 65 \pm 3 \text{ }\mu\text{m}$, and $\eta_w = 75 \pm 5 \text{ }\mu\text{m}$. We will discuss the influence of the turbulent fluctuations in the surrounding air on the dispersion of droplets.

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