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Experimental Investigation of Lagrangian Statistics of Motion of Diesel Oil Droplets and Fluid Particles in Isotropic Turbulence[1] BALAJI GOPALAN, EDWIN MALKIEL, JOSEPH KATZ, Johns Hopkins University — Lagrangian motion in isotropic turbulence of slightly buoyant diesel oil droplets (specific gravity 0.85 and size 0.6-1.1 mm) and almost neutrally buoyant, 50 μm tracer particles are studied using high speed, in-line digital holographic cinematography. Droplets and particles are injected into a 50x50x70 mm^3 sample volume located at the center of a nearly isotropic turbulence facility, and data are obtained for Re_λ of 190, 195 and 214. The turbulence is characterized by 2D PIV measurements at different planes. An automated tracking program has been used for measuring velocity time history of more than 22000 droplet tracks and 15000 particle tracks. Analysis compares probability density functions (PDF) of Lagrangian velocity and acceleration, spectra, as well as velocity and acceleration autocorrelation functions of droplets with those of particles. For most of the present conditions, rms values of horizontal droplet velocity exceed those of the fluid. The rms values of droplet vertical velocity are higher than those of the fluid only for the highest turbulence level. PDFs of droplet velocity have nearly Gaussian distributions, justifying use of Taylor's (1921) model to calculate diffusion parameters. The fluid particle diffusion coefficient exceeds that of the droplet primarily because the fluid diffusion timescale is higher than that of the droplet. For all droplet sizes and Reynolds numbers, the diffusion coefficient, calculated using Taylor's model, scaled by quiescent rise velocity and turbulence integral length scale, is a monotonically increasing function of the turbulence level normalized by droplet quiescent rise velocity.

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