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Velocity and acceleration statistics from direct numerical simulations (DNS) of particle-laden homogeneous turbulent shear flow PARVEZ SUKHESWALLA, ANDREW BRAGG, LANCE COLLINS, Cornell University — We study the effects of imposed mean shear and gravity (acting normal to shear) on the velocity and acceleration statistics of inertial particles in homogeneous turbulent shear flow. Single- and two-particle statistics from high-resolution DNS are analyzed for various particle sizes, shear rates, and settling parameters. We find that mean particle settling speeds are enhanced by turbulence, and are sensitive to changes in shear and gravity. Also, the net drift of particles due to gravity increases their locally averaged velocities in the mean-flow direction. Particle-pair relative velocities are anisotropic, with the radial inward component and the second-order structure function both maximal along the mean-strain contractional axis. Stronger shear shifts this orientation towards the mean flow streamlines, reflecting the larger particle fluctuating velocities in that direction. Gravity and shear together cause particle r.m.s. accelerations to increase with increasing inertia, in contrast to isotropic turbulence, but consistent with past turbulent boundary layer experiments. Analytical predictions for particle mean velocities and accelerations agree well with the DNS data. These results have important implications for the anisotropic collision kernel in shear flow.

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