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Effects of small particles on coherent structures in particle-laden near-wall turbulence JUNGHOON LEE, CHANGHOON LEE, Department of Computational Science and Engineering, Yonsei University, Seoul, Korea — In near-wall turbulence, particles interact effectively with coherent structures, such as the quasi-streamwise vortices near the wall. The quasi-streamwise vortices play a significant role in turbulence production and regeneration. In this study, we investigate the modification of the quasi-streamwise vortices due to the presence of particles using direct numerical simulation of turbulent channel flow. The particles considered are smaller than the Kolmogorov length scale and the particle Reynolds numbers are small. Therefore, a point-force approach was used in imposing the particle reaction force on the fluid. Since particles are assumed to be heavier than the fluid, the particle equation of motion was established considering only Stokes drag. In this study, the particle Stokes numbers based on wall units range from 0.5 to 25. It is shown that particles with the lowest Stokes number augment turbulence while particles with higher Stokes numbers attenuate it. The lowest-Stokes-number particles are found to enhance the low- and high-speed streaks around the quasi-streamwise vortices, affecting vortex regeneration cycle. Consequently, the frequency of the quasi-streamwise vortices is increased. However, particles with higher Stokes numbers directly damp the quasi-streamwise vortices.

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