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Turbulent channel flow laden with finite-size neutrally-buoyant particles[1] FRANCESCO PICANO, KTH Mechanics, WIM-PAUL BREUGEM, Aero & Hydrodynamics Dep., TU-Delft, LUCA BRANDT, KTH Mechanics —
Dense suspensions are widely encountered in many applications and in environmental flows. While their rheological features in laminar flows have been longly studied, much less is known on their behavior in turbulent/inertial regime. The present works aims to fill this gap by investigating the turbulent channel flow of a Newtonian fluid laden with rigid neutrally-buoyant spheres at relatively high volume fractions. An Immersed Boundary Method has been used to account for the phase interaction performing Direct Numerical Simulation in the range of volume fractions $\Phi = 0 - 0.2$ and a typical particle radius of 10 wall units. The results show that the mean velocity profiles are significantly altered by the presence of a solid phase with a decrease of the von Karman constant in the log-law. The overall drag is found to monotonically increase with the volume fraction. At the highest volume fraction here investigated, $\Phi = 0.2$, the velocity fluctuation intensities and the Reynolds shear stress are found to decrease. The analysis of the mean momentum balance shows that the particle-induced stresses govern the dynamics in the dense cases and are responsible of the the overall drag increase since the turbulent shear stress is reduced with respect the unladen case.

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