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Hydrodynamic force and torque models for a particle moving near a wall at finite particle Reynolds numbers[1] GUODONG JIN, ZHIDENG ZHOU, LNM, Institute of Mechanics, Chinese Academy of Sciences — We present models for the hydrodynamic force and torque experienced by a spherical particle moving near a solid wall in a viscous fluid at finite particle Reynolds numbers. In order to account for the effects of finite particle Reynolds number, we use four types of simple motions at different particle Reynolds numbers. Using the lattice Boltzmann method, we fully resolve the flow field near the particle and obtain the models for hydrodynamic force and torque as functions of particle Reynolds number and the dimensionless gap between the particle and the wall. The resolution is up to 50 grids per particle diameter. After comparing numerical results of the coefficients with conventional results based on Stokes flow, we propose new models for hydrodynamic force and torque at different particle Reynolds numbers. Furthermore, the models are validated against general motions of a particle and available modeling results from literature. The proposed models could be used as subgrid scale models where the flows between particle and wall can not be fully resolved, or be used in Lagrangian simulations of particle-laden flows when particles are close to a wall instead of the currently used models for an isolated particle. Details please refer to Int. J. Multiphase Flow, 92:1-19 (2017).

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