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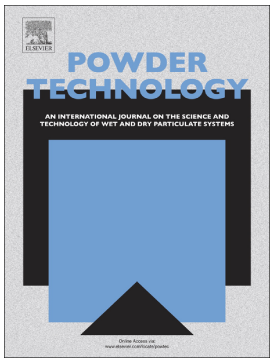

Particle resolved direct numerical simulation of free settling particles for the study of effects of momentum response time on drag force

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Particle resolved direct numerical simulation of free settling particles for the study of effects of momentum response time on drag force

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Abstract

Dynamics of settling particles is studied by particle resolved direct numerical simulation in periodic domain. The main aim of this study is to explain the effects of momentum response time on the average drag force of settling process for different solid volume fractions. The response time is varied by changing the settling fluid, solid volume fraction and Reynolds number. Simulations showed that the particles with larger response times are negligibly affected by fluid. Thus, the average drag force acting on larger response times particles is nearly same as the average drag force on fixed particles. However, for particles with smaller response times, particles develop microstructures and velocity fluctuations during settling process. This behavior of low response time settling particles results in significant deviation of average drag force from the average drag force on fixed particles. At the end of paper, an improved and better drag correlation is proposed for performing mesoscopic simulations.

Keywords: Momentum response time, Drag force, Settling of particles, Particles structures in settling, Particle resolved direct numerical simulations

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