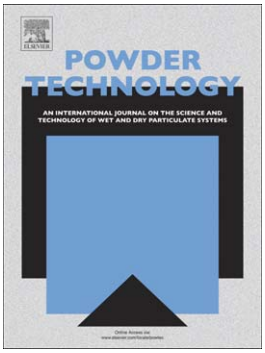

Large-eddy simulation of turbulent preferential concentration and collision of bidisperse heavy particles in isotropic turbulence

Jincai Chen, Guodong Jin

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Large-eddy simulation of turbulent preferential concentration and collision of bidisperse heavy particles in isotropic turbulence

Jincai Chen[a,b], Guodong Jin[a,b,*]

[a] *LNM, Institute of Mechanics, Chinese Academy of Sciences, Beijing 100190, China*
[b] *School of Engineering Science, University of Chinese Academy of Sciences, Beijing 100049, China*

Abstract

Particle-laden turbulent flows are ubiquitous in natural and engineering flows. The preferential concentration and pair-statistics of heavy particles at small and intermediate Stokes numbers are mainly related to the small-scale motions, which are missing in conventional large-eddy simulation (LES). Therefore, studies on the effects of subgrid scale (SGS) motions on particle-pair statistics are significant. This paper will study the effects of SGS motions on the collision-related statistics of a bidisperse system that involves two groups of particles at different Stokes numbers using a direct numerical simulation (DNS), filtered DNS (FDNS) and LES. Compared with a monodisperse system at a single Stokes number, the relative error of the collision rates in the bidisperse system is much smaller than that in the monodisperse one. For given filter widths and Stokes numbers, the relative errors between the FDNS and LES are much smaller than their relative errors to DNS, implying that the error caused by the filtering operation in LES plays a leading role in the overall error of the particle collision rate at Stokes numbers less than 3. A particle SGS model is, thus, necessary to consider the effect of SGS motions on bidisperse heavy particles.

Keywords: particle-laden turbulence, large-eddy simulation, subgrid scale motion, bidisperse particles, preferential concentration, collision rate

*Corresponding author
Email address: gdjin@lnm.imech.ac.cn (Guodong Jin)