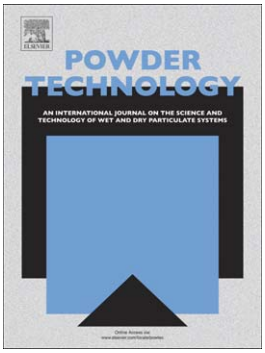

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A fine LES-DEM coupled simulation of gas-large particle motion in spouted bed using a conservative virtual volume fraction method

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Abstract

In conventional CFD-DEM based on the cell-averaged-volume-fraction (CAVF), mesh size for gas phase is required to be larger than particle size. It is good for fine particles, whereas too coarse for large particles. A conservative virtual volume fraction method is proposed here for sub-particle LES-DEM coupled simulation of large particles. Although still based on CAVF, mesh size is smaller than particle size, and the LES-DEM coupled solution on finer grids incorporating the Smagorinsky sub-grid-scale stress tensor is proposed. The feedback force is redistributed onto the finer grids to perform the four-way coupling on fine scales. It is conservative for the inter-phase interactions between the super-particle (for drag force) and sub-particle (for feedback force) scales through the same distribution function. The 2D case and the 3D cases with or without LES are performed to demonstrate the capability of this model, and validated by an experiment of spouted bed. The important features on gas-phase are illustrated to demonstrate the application for capturing the gas-phase behavior on sub-particle scales.

Keywords: LES-DEM, coupled simulation, gas-particle flow, sub-particle scale, virtual void fraction function, discrete element method, spouted bed.

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