A scaled MP-PIC method for bubbling fluidization

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Abstract

Coarse-grained methods have been widely used in simulations of gas-solid fluidization. However, as a key parameter, the coarse-graining ratio, and its relevant scaling law is still far from reaching a consensus. In this work, a scaling law is developed based on a similarity analysis, and then it is used to scale the multi-phase particle-in-cell (MP-PIC) method, and validated in the simulation of two bubbling fluidized beds. The simulation result shows this scaled MP-PIC can reduce the errors of solids volume fraction and velocity distributions over a wide range of coarse-graining ratios. In future, we expect that a scaling law with consideration of the heterogeneity inside a parcel or numerical particle will further improve the performance of coarse-grained modeling in simulation of fluidized beds.

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Table. 1 Scaling laws for coarse-grained models in literature.docx available at <https://authorea.com/users/436207/articles/538701-a-scaled-mp-pic-method-for-bubbling-fluidization>

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Table. 2 The characteristic quantities adopted in dimensionless equation.docx available at <https://authorea.com/users/436207/articles/538701-a-scaled-mp-pic-method-for-bubbling-fluidization>

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Table. 3 Sample particle parameters in original and scaled MP-PIC.docx available at <https://authorea.com/users/436207/articles/538701-a-scaled-mp-pic-method-for-bubbling-fluidization>

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Table. 4 Numerical settings for bubbling bed 165 and bed 266.docx available at <https://authorea.com/users/436207/articles/538701-a-scaled-mp-pic-method-for-bubbling-fluidization>