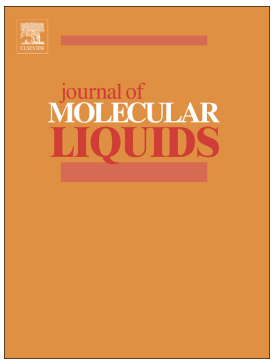

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Sedimentation of Elliptical Particles using Immersed Boundary – Lattice Boltzmann Method: A complementary repulsive force model

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Abstract

In the current study, a hybrid direct forcing Immersed Boundary-Lattice Boltzmann Method is employed to study the geometry and size effects of falling elliptical particles. A developed short-range repulsive force model has been proposed which is able to duly simulate the sedimentation of single and multiple various sized and shaped particles. This model will benefit insight into the settling behavior of non-circular particles. The proposed procedure is adequately validated by comparing to the existing results. The effects of aspect ratio, density ratio and initial orientation for a single ellipse falling in a thin box are investigated. The dynamics of two identical ellipses are analyzed in various configurations. Results suggest when the major axis is perpendicular to gravity direction, particles move severely toward the wall. The effect of initial inclination is investigated. In order to demonstrate the capability of the presented method, the sedimentation of 20 particles with different shapes and sizes has been conducted, simultaneously. The results display that larger particles exchange their locations with smaller ones and the smaller elliptical particles tend to save their initial orientations in comparison with larger particles.

Keywords: Particulate flow, Elliptical particle, Repulsive force, Immersed Boundary method, Lattice Boltzmann Method, Size ratio.

Nomenclature

A	Surface Area	s	Solid body
b	Major axis	t	Time
C	Scaling factor	T_{tot}	Total torque acting on the particle
c	Lattice speed	$\vec{u}$	Velocity
$D(r)$	Dirac delta function	u^{noF}	Unforced velocity

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