A COMPREHENSIVE PARAMETRIC STUDY OF LBM-DEM FOR IMMERSED GRANULAR LOWS

GENG CHAO YANG, LU JING, CHUNG YEE KWOK, AND YURI DUMARESQ SOBRAL

Abstract. Simulating the flow of particles fully immersed in a fluid is a difficult computational problema and, despite all the progress that has been achieved in the field, there is still a concern about the accuracy of predictive models for immersed granular flows, especially when complex fluid-particle interactions play a non-negligible role in the dynamics of the flow. In this work, we present a detailed parametric study of a fluid-particle computational model that couples the Lattice Boltzmann Method (LBM) with the Discrete Element Method (DEM) using an immersed moving boundary technique [1, 2, 3]. Benchmark cases with increasing complexity are simulated to understand the numerical accuracy, stability and efficiency of the algorithm. A guideline for a high-quality LBM-DEM model is proposed and applied to a test case of granular collapse in water. The simulation result shows excellent agreement with experiments, which demonstrates the capability of LBM-DEM to describe the dynamics of densely packed and friction dominant immersed granular flows, highlighting its potential to study geophysical mass movements [4].

Keywords: Immersed moving boundary, Granular collapse, discrete element method, Verlet, Lattice-Boltzmann

Mathematics Subject Classifications (2010): 76T25, 76M28.

References

[1] S. Chen, G.D. Doolen Lattice Boltzmann method for fluid flows *Ann Rev Fluid Mech*, 30(1), 329-64, 1998.
[2] P.A. Cundall, O.D.L. Strack A discrete numerical model for granular assemblies *Geotechnique*, 29(1), 47-65, 1979.
[3] D.R. Noble, J.R. Torczynski A Lattice-Boltzmann method for partially saturated computational cells. *Int J Modern Phys C*, 09(08), 1189-201, 1998.
[4] G.C. Yang, L. Jing, C.Y. Kwok, , Y.D. Sobral A comprehensive parametric study of LBM-DEM for immersed granular flows *Computers and Geotechnics*, 114, 103100, 2019.

School of Aeronautics and Astronautics, Sun Yat-sen University, Shenzhen, China
Email address: yanggch8@sysu.edu.cn

Tsinghua Shenzhen International Graduate School, Tsinghua University, Shenzhen, China
Email address: lujing@sz.tsinghua.edu.cn

Department of Civil Engineering, The University of Hong Kong, Hong Kong
Email address: fkwok8@hku.hk

Departamento de Matemática, Universidade de Brasília, Brasília, Brazil
Email address: ydsobral@unb.br