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LARGE DEFORMATION MODELLING IN GEOMECHANICS

Kenichi Soga[1]

[1]Department of Civil and Environmental Engineering
University of California, Berkeley
e-mail: soga@berkeley.edu

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Geophysical hazards, such as avalanches, debris flows and submarine landslides, involve rapid and large mass movement of granular solids, water and air as a single-phase system. The momentum transfer between the discrete and continuous phases significantly affects the dynamics of the movement. This study aims to understand the ability of continuum models in capturing the micro-mechanism of granular flow dynamics. Most macroscopic models are able to capture simple mechanical behaviours, however the complex physical mechanisms that occur at the grain scale, such as hydrodynamic instabilities, the formation of clusters, collapse, and transport, have largely been ignored. In this study, to understand the evolution of immersed granular flows, Material Point Method (MPM), a hybrid Lagrangian and Eulerian approach is used to describe the continuum behaviour of granular flow dynamics ([1], [2], [3], [4]), while the micro-mechanics is captured using Discrete Element Method coupled with the Lattice Boltzmann Method (LBM) for fluid-grain interactions ([5], [6], [7], [8]). A parametric analysis is performed to assess the influence of the grain sample characteristics (initial configuration, permeability, slope of inclined plane) on the evolution of flow and run-out distances. The effect of hydrodynamic forces and hydroplaning on the run-out evolution is analysed by comparing the mechanism of energy dissipation and flow evolution in dry and immersed granular flows.

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