Seminário de Mecânica

Numerical simulations of immersed granular collapses with dense and loose initial packings

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Abstract.

The collapse of granular columns in a viscous fluid is a common model case for submarine geophysical flows. In immersed granular collapses, dense packings result in slow dynamics and short runout distances, while loose packings are associated with fast dynamics and long runout distances. However, the underlying mechanisms of the triggering and runout, particularly regarding the complex fluid-particle interactions at the pore-scale, are yet to be fully understood. In this study, a three-dimensional approach coupling the Lattice Boltzmann Method and the Discrete Element Method is adopted to investigate the influence of packing density on the collapsing dynamics. The direct numerical simulation of fluid-particle interactions provides evidence of the pore pressure feedback mechanism. In dense cases, a strong arborescent contact force network can form to prevent particles from sliding, resulting in a creeping failure behavior. In contrast, the granular phase is liquefied substantially in loose cases, leading to a rapid and catastrophic failure. Furthermore, hydroplaning can take place in loose cases due to the fast-moving surge front, which reduces the frictional resistance dramatically and thereby results in a longer runout distance. More quantitatively, we are able to linearly correlate the normalized runout distance and the densimetric Froude number across a wide range of length scales, including small-scale numerical/experimental data and large-scale field data.