EGU23-8143, updated on 22 Apr 2024
https://doi.org/10.5194/egusphere-egu23-8143
EGU General Assembly 2023

On the effect of vibration on dry/fluid-saturated granular flows: Implications for geological hazards induced by earthquakes

Yuhan Wang[1], Wuwei Mao[2], and Elías Rafn Heimisson[1]
[1]Swiss Seismological Service, ETH Zurich, Zurich, Switzerland (yuhan.wang@sed.ethz.ch, elias.heimisson@sed.ethz.ch)
[2]Department of Geotechnical Engineering, College of Civil Engineering, Tongji University, China (maowuwei@tongji.edu.cn)

Vibrating boundaries are widely encountered, for example, between soil and bedrock during earthquake shaking. We understand that vibration of such boundaries can lead to instabilities in granular media with many applications to geological hazards, such as liquefaction and landslides, and during geological engineering applications. Although numerous studies have been dedicated to revealing the behavior of granular flows under various flowing regimes, the significance of vibrating boundaries remains an open problem. To fill this gap, we introduce a vibrating base boundary into the collapse of a granular column with a numerical scheme. To understand the role of fluids, we contrast the behavior of granular flows under dry and fluid-saturated conditions. From the simulations, the development of anisotropy in spatial inter-grain contact force distribution is studied. The fluid-saturated condition is achieved via a two-way coupled CFD-DEM method. From these simulations, a scaling law of granular flow is derived for vibrating boundaries. We illustrate for the first time the energy evolution of the granular system with vibrating boundaries. This work demonstrates the role of vibration in increasing the runout distance and the maximum kinetic energy of granular flows, this suggests a link between the mesoscale inter-grain responses and macro-scale dynamics of granular geological hazards triggered by earthquakes. Additionally, the spatial distribution of inter-grain contact forces is presented under dry and fluid-saturated conditions to indicate the anisotropic development inside the granular assembly.