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Global Discrete Element Method for Friction

Dry Granular Flows Over Erodible Beds

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Material composed of grains can be found everywhere at any size, from capsules in pharmaceutical industry to sand, gravels and rocks in constructions and in natural hazards such as landslides. From antiquity, civilizations are used to take advantage of the granular media properties. For instance, Egyptians used the sand behaviours between fluid and solid to erect their obelisks guarding the risks of breaking during the process [1]. However, due to the high complexity of the granular media, our understanding of these material is still limited and we must often restrict our studies to simplified situations like simple interacting spheres under well controlled physical parameters in laboratory.

In order to describe the dynamics of this idealized media, a lot of models have been developed during the last three decades each with different degrees of complexity. From the simplest depth-averaged methods neglecting the vertical accelerations, to more complete models solving the Navier-Stokes equations with a specific rheology for the granular material [2], or the Discrete Elements Methods (DEM) based on the time integration of the movement of each particle taking into account the movement of all the neighbouring ones [3].

In DEM, despite the fact that equations in time are coupled over all the contact network, their numerical resolution is often realized through an iteration contact by contact during a time step. In this presentation, we propose a DEM formulation derived from a global frictionless model developed in [4], where the numerical resolution is made over the entire contact network and based on the non-linear contact laws of Signorini and Coulomb.

The mathematical formulation and numerical scheme will first be introduced. Then, comparisons between laboratory experiments and numerical simulations will be presented to validate the model. A special focus into numerical simulations of dry granular flows over erodible beds will be explored.

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