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Simulation of dry granular flows using discrete element methods

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Granular flows are composed of interacting particles (for instance sand grains). While natural flow simulations at the field scale are generally based on continuum models, discrete element methods are very useful to get insight into the detailed contact interactions between the particles involved. We shall consider here both well known molecular dynamics (MD) and contact dynamics (CD) methods to simulate granular particle interaction. The difference between these methods is the linearisation of contact forces in MD. We are interested to compare these methods, and especially the effects of the linearisation in simulations.

In the present work, we introduce a new rigid bodies model at the scale of the particles and its resolution by contact dynamics. The interesting aspect of our CD method is to treat the contacts in all the material system in one step without any iterative process required when the contacts are dealt with one after the other. All contacts are calculated here at the same time in just one iteration and the normal and tangential constraints are treated simultaneously. The present model follows from a convex optimization problem presented in [1] by B. Maury in which we add a frictional behaviour to the contact law between the particles.

To analyse the behaviour of this model, we compare our results to analytical solutions when we can compute them and otherwise to simulations with molecular dynamics method.

[1] A time-stepping scheme for inelastic collisions. Numerical handling of the nonoverlapping constraint, B. Maury, Numerische Mathematik, 17 january 2006.