INVITED SESSION

Numerical modelling of impacts of/on granular media

ORGANIZERS
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ABSTRACT

The dynamic interaction of flowing granular masses with rigid/deformable obstacles or, alternatively, the impact of objects on granular strata is characterised by large displacements, large strain rate values, damage processes, waves propagation and reflection and the arising of inertial forces. In some cases, and in particular when the granular material is saturated, or when the impact is characterised by a high energy content, the event is associated with phase transition phenomena. In fact, granular media may behave like either solids or fluids according to their current grain packing and strain rate. In the first case the energy is mainly stored by the system by means of permanent force chains, whereas in the second as kinetic fluctuating energy.

These impact processes are typically studied in case of landslides or rockfalls for risk mitigation purposes, in many engineering applications for instance to optimise installation procedures of geotechnical structures (e.g. pile driving), and to improve soil properties, but are studied also for military applications and for describing the impact of celestial bodies on the earth.

Impacts can be numerically simulated by using either discontinuum or continuum-based approaches. Within the former category very popular is the Discrete Element Method (DEM) which is capable of taking large displacements as well as the discrete nature of the material into account, even if is inefficient for the solution of very large dimension boundary value problems and not suitable for saturated conditions. To overcome this second limitation, very recently, DEM codes are starting to be used in association with continuum based numerical approaches (simulating the liquid phase) to account for hydromechanical coupling.

Alternatively, fully continuum-based methods require the implementation of constitutive models capable of reproducing the mechanical behaviour of the material under both solid and fluid regimes and numerical formulations such as Smoothed Particles Hydrodynamics (SPH), Material Point Method (MPM) and Particle Finite Element Method (PFEM) suitable for dealing with large displacements, large strain rates and heterogeneous and multiphase granular media.
The objective of this thematic session is to present and discuss the use of particle-based methods for modelling impact processes involving granular materials and obtaining macroscopic data, such as time evolution of interaction forces, very useful for design purposes. The session is also intended to encourage the use of particle-based methods for studying phenomena such as phase transition, waves propagation and reflection, as well as all the energy storage/dissipation mechanisms characterizing the granular materials under dynamic conditions with the aim of mechanically and physically interpreting the macroscopic observations.