NUMERICAL ANALYSIS OF THE ONSET OF SHEAR INSTABILITY IN GRANULAR SAMPLES

L. Staron (1), J.-P. Vilotte (1) and F. Radjai (2)

(1) Institut de Physique du Globe de Paris, (2) Laboratoire de Mécanique et Génie Civil de Montpellier

The behaviour of granular matter (sand, gravel...) is a problem of great interest in geophysics since such material is omnipresent on the Earth surface, and is involved in numerous phenomenon: fault gouges, erosion and transport, landslides etc. The behaviour of granular media results from the multiple and dissipative interactions between the grains, and obeys a complexe "multi-contact" structure. The mechanisms ruling granular matter dynamics remain partly open to question. In this work, we are more specifically interested in the trigger of shear instability in an initially resting granular system. In order to analyse this process accurately, we carry numerical two-dimensional simulations using the Contact Dynamics method, so as to know all contact forces and grains velocities in the samples.

Our results proceed from the analysis of two numerical experiments: in the one hand granular piles driven towards avalanching through continuous tilt under gravity, and in the other hand planar bi-periodic samples in shear cells. We study the transition from static equilibrium to motion when analysing the organization of contact forces transmission, and when detailing the mobilization of friction forces at contacts. We give evidence of the occurrence of intermittent dynamical reorganizations of the packing. These forewarning instabilities are related to the appearance of clusters of contacts where friction forces are fully mobilized and where slip motion is thus allowed. These instable areas are caracterized by a higher deviatoric load. Their mean size diverges following a percolation-like process at the onset of the shear instability. The later
thus appears as the signature of a phase-transition like mechanism. These results are in favour of a biphasic picture of the behaviour of granular matter at stability threshold.