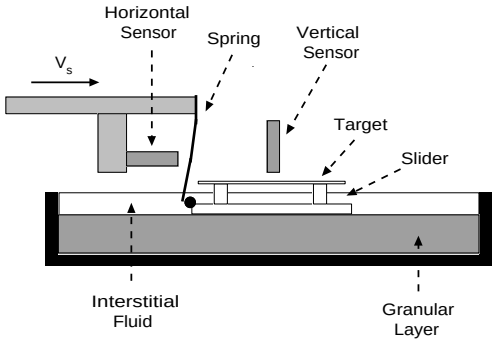
Thibaut DIVOUX,
email: thibaut.divoux@ens-lyon.fr
webpage: http://perso.ens-lyon.fr/thibaut.divoux/

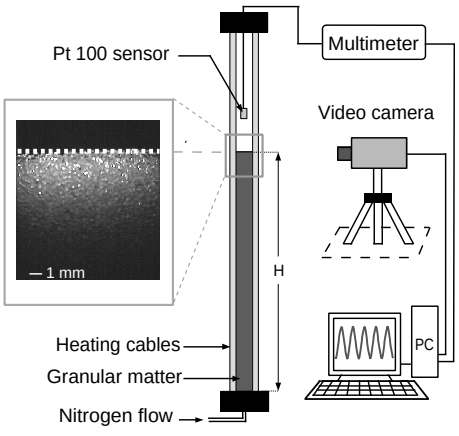
Granular Materials: from creeping flows to the jamming transition

In collaboration with **Jean-Christophe Géminard**, **Hervé Gayvallet** & **Pierre Borgnat**.

A granular assembly at rest is an isostatic system, i.e. the number of static equations equals the number of unknowns; Thus, granular packings are very sensitive to any external perturbation. As a consequence, a granular packing gently sollicitated, e.g. slowly sheared, submitted to small amplitude vibrations or to cycles of temperature, experiences a *critical transition* (called the *jamming transition*) between a **jammed state** and a **creeping flow** state. From this angle, granular matter is one of the best candidates to probe the ideal glass-transition which has been, and is still actively studied by physicists. In order to investigate experimentally both dry and immersed granular matter in the limit of this transition, we developped the two following set-ups in the laboratory:

- First, a classic friction experiment which consists in a sliding plate slowly pushed over a dry or immersed granular layer, which makes it possible to monitor both the **friction force** between the plate and the granular layer, and also the **dilatancy** experienced by the granular layer when sheared. We have shown that the mean value of the friction force (friction coefficient) depends neither on the geometric properties of the plate nor on the fluid viscosity or the grain size, in the limit of small shear-rate. We have also conducted a complete study on the **fluctuations** that both the friction force and the dilatancy exhibit in the steady state regime.





- Second, a brandnew set-up which makes it possible to impose cycles of temperature (up to a few thousands) to a granular column and to accurately monitor the top column dynamics (a few microns resolution). Under the successive dilations and contractions, the grains experience local rearrangements which lead to the slow compaction of the whole column. The control parameter is the penetration length imposed by the cycles of temperature at the border of the container. We also found out a transition between two dynamic behaviours of compaction: namely, a continuous compaction induced at each cycle (high ΔT), or a compaction by jumps separated by few to numerous cycles (low ΔT).

Related articles

- **Creep motion of a granular pile induced by thermal cycling,**
  T. Divoux, H. Gayvallet, & J.-C. Géminard, Phys. Rev. Lett. **101**, 148303 (2008).
- **Friction and dilatancy in immersed granular matter,**
  T. Divoux & J.-C. Géminard, Phys. Rev. Lett. **99**, 258301 (2007).