Thesis proposal

Particulate Materials under Compaction

The compaction of particulate materials is one of the most important industrial processes. It is used to manufacture net or near-net shape components with complex geometries and high tolerance, and with souhaitable strength. The compaction process transforms a loose particulate material into a compacted product with a higher density. A typical compaction industrial process consists of four main stages: (i) die filling; (ii) transfer; (iii) compaction; and (iv) ejection. By focusing on the compaction and ejection stages of the compaction process, the *objective of the thesis is to investigate the relation between the macroscopic behaviours and the characteristics of particles when the system is subjected to the compaction loading and unloading, using a numerical framework.*

The framework is based on a combination of the Bonded-Cell Method (BCM) for brittle particles and the MPM-CD approach for ductile particles. The MPM-CD combines the Material Point method (MPM) to deal with particle deformability and the Contact Dynamics (CD) method to treat the interactions (friction, adhesion…) between particles. This combined numerical procedure will be applied to investigate the rheology and texture of particulate materials subjected to compression loading and unloading. As long as particle deformation remains small, the stress state can be described by the distribution of contact forces (force chains) and their anisotropy whereas the macroscopic strains reflect either small elastic contact deflections or particle rearrangements. Beyond the small deformation regime, however, the prevailing mechanism turns to particle shape change due to extensive deformation and/or fragmentation. The transition from a jammed state towards a particle shape change state will be studied by applying a uniaxial compressive strain rate or pressure on the packings. Note that experiments can also be planned to support numerical simulations.

This PhD thesis will take place at the *Laboratoire de Mécanique et Génie Civil (LMGC)-CNRS-Université de Montpellier-France* in collaboration with the *INRAE Montpellier* and the *University of Leeds*.

Highly motivated candidates with a master's degree in physics or mechanics, or graduated from an engineering school, and interested in numerical modelling are encouraged to apply.

For more informations or applying to the PhD thesis, please contact *Saeid Nezamabadi* (saeid.nezamabadi@umontpellier.fr).