11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Multiscale modeling of multi-component granular avalanches

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Keywords: micro-macro transition, granular flow, mixture theory, segregation.

Geophysical flows (e.g. snow slab avalanches, debris flows and pyroclastic flows and landslides) often contain particles of different sizes, shapes and materials, which can cause the constituent phases to segregate. Here we will focus of the effects of size and density. Kinetic sieving causes the particles to segregate by size, with small particles sifting downwards, as they have a higher probability than large particles to fit into void spaces [1]. The large particles on the surface are transported sideways to form levees that increase the resistance to lateral motion and thus enhance the run-out. At the same time, particles also segregate by density due to buoyancy, which shifts lighter particles upwards.

For bidisperse flows, a mixture-theory continuum model is used that includes the effects of both size and density segregation [2]. We use DEM (DPM) simulations to investigate two key model parameters that are hard to obtain from experiments. A novel coarse-graining expression for the stress tensor of discrete mechanical systems is applied for mixtures to obtain the partial stresses and the interaction drag force [3,4]. The goal is to develop predictive multi-component models of granular avalanches by utilising both continuum and particle simulation approaches.

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