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Segregation mechanisms in granular systems: role of gravity and velocity fluctuations

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Size segregation patterns are often observed in natural granular systems: dune fields, debris flow deposits, river beds, asteroids surface... Identifying the underlying mechanisms and dynamics would be a significant progress towards understanding the evolution of these systems: discrimationsbetween different processes, relevant time-scales, history of the mechanical solicitation.
In the case of the surface of asteroids exhibiting a granular nature, such as Itokawa, the origin of sorting patterns following grain size may have different origins. It can occur as a result of periodic changes in the gravity field, or seismic-shaking due to impacts, or be the signature of re-deposition of ejected material after impacts. It may also be related to size-dependent thermal weathering or impact bouncing dynamics, rather than mechanical segregation. It is thus crucial to explore the different candidate mechanisms and address their likeliness in spatial context.
In this contribution, we use a discrete simulation model to reproduce the collective behaviour of rigid, frictional grains exhibiting different sizes. Segregation dynamics is obtained during gravity-driven flows, allowing for the detailed investigation of the micro-mechanical signature of segregation. In particular, we evidence the asymetry of the stress state induced by the different grain sizes. Discriminating between contacts stresses and kinematic stresses, we are able to discuss the respective role of gravity and velocity fluctuations in the segregation process.

References

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