Particles impact on granular media

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Abstract

Grain transport by saltation is involved in numerous geophysical phenomena such as wind-blown sand, snow drift, aeolian soil erosion, dust emission, etc. Particle impacts on a granular bed trigger rebound and ejections processes, which can lead in certain conditions to a steady state of solid transport. The present work is dedicated to the analysis of the impact processes at the grain scale, with the objectives of inferring robust statistical laws and better understanding granular transport, accounting for the possible role played by adhesion between the grains.
The study is based on numerical simulations with the DEM (Discrete Element Method). The numerical experiments consist in throwing a spherical particle on a granular packing with controlled velocity (Froude number between 0 and 200) and impact angle (between 10◦ and 90◦). The contact model (friction, cohesion) between the grains is varied to represent different types of granular materials (e.g., dry sand, wet sand, snow). We investigated the influence of incident parameters on the impact process, focusing on the incident particle rebound and on the number and energy of ejected particles. For non-cohesive granular beds, the simulations were compared to laboratory experiments. In particular, the restitution coefficient of the incident particles and the number of ejected particles were found in good agreement with experimental results. The simulations also give access to quantities that cannot be easily measured in the experiments. In particular, we analyzed the statistical relation between the number, the energy, the locations of the ejected particles and the impact

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velocity and angle.
Preliminary results concerning cohesive granular beds will also be presented, considering contact laws representative of liquid (capillary) and solid cohesion processes. Effect of cohesion on the number of ejected particles, and energy dissipation processes within the cohesive granular beds, will be discussed.
These detailed analyses allowed us to identify the physical processes associated with the ejection mechanisms and their relative influence for non-cohesive and cohesive materials.