Effect of cohesive forces on fluctuations in granular flows: linking experiments and simulations

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ABSTRACT

Granular flow is a complex process as it depends on a large set of parameters such as grain morphology, surface friction, flow rate and cohesion (e.g. attractive interaction between grains). Experimentally, the latter arises from the presence of humidity, electrostatic charges or Van der Waals forces within the granular material that lead to the appearance of surface flow fluctuations also called avalanches. Those surface fluctuations produce a highly intermittent granular flow and thus determine the flowability of a powder.

In order to quantify the intensity of the cohesion between grains, we reproduced numerically the 2D flow of cohesive granular materials in a rotating drum. By implementing simplified cohesive interactions between circular grains and measuring the surface flow fluctuations, we show that there exists a scaling between the intensity of cohesion to the size of avalanching aggregates. This relation between cohesion and surface fluctuations and the interpretation of the numerical simulations allows us to adapt a theoretical model of granular flow by Dury et al. (1998) to the flow of cohesive granular materials.

Finally, we compared the numerical results with measurements performed with GranuDrum instrument (a powder flow analyzer based on the rotating drum geometry). A set of powders commonly used in industries were considered.

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