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A experimental study on the planar granular column collapse

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Granular flows are a common phenomenon encountered in diverse situations such as rock avalanches, landslides, debris flows and pyroclastic flows. There is an absence of a generalized constitutive set of equations able to describe the transitional motion and behaviour of granular flows. The latter is due to the remarkable behaviour of granular media as a gas, a solid, or a liquid, depending on the scenario (i.e. initial state, boundary conditions, and stress-strain rate solicitations). The granular column collapse is a benchmark model able to reproduce transitional granular flows in a small scale, allowing the simplification of the phenomenon dynamics, were a granular column is quickly released over a horizontal surface and collapses by self-weight. Previous work on granular column collapses covers axisymmetric and quasi-two-dimensional configurations [1, 2, 3] However, the ratio between initial column width and particle size, and the influence of the opening mechanism remains unexplored.

Here, we revisit the experiments of Lacaze et al. (2008), propose an optimized gate mechanism that releases all particles in contact with it instantaneously, and study the column collapse dynamics, from release to deposition, by use of digital image analysis. In our experiments, the distance between bounding walls is small enough in order that only one particle can pass by. Within it, a monodisperse set of dry glass beads are stacked up behind the gate. The gate releases the flow by moving in a plane perpendicular to the flow direction. We study the corresponding scaling principles for different parameters (i.e. runout distance, aspect ratio, collapse time, and velocity profile). Moreover, the transition between potential and kinetic energy is computed in conjunction with the shear-band evolution. Finally, we discuss the promising alternatives to adapt the set-up for the study of the granular column collapse in submerged, saturated, or partially saturated conditions.

References

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