Use of Collision and Flow Properties of Particles Falling From a Hopper to Estimate the Damping Coefficient in the DEM

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ABSTRACT

The discrete element method (DEM) has been increasingly used over the past twenty years or so to gain insight into the mechanisms that govern the flow of particles in many processes and applications. DEM-based models bring into play a set of physical parameters, the value of which must be determined. In addition to the particle size, shape and density, we can cite the Young's modulus, the Poisson ratio, the damping coefficient, which are related to the coefficient of restitution, as well as the static and dynamic friction parameters and, for relevant systems, the particle surface energy. If the former parameters can be measured relatively well, it is widely admitted that the latter parameters, which play an important role in the nature of the particle collisions, are much more difficult to evaluate.

This work proposes a technique that backs out the value of the damping coefficient from the flow and collision properties of particles when they exit a hopper. More precisely, it links the flowrate of particles and the geometrical properties of the cloud they form at the exit of the hopper, to the value of the damping coefficient and also to that of the coefficient of restitution. First, the method is explained in detail and supported by DEM simulations carried out using both our proprietary software and open source code LIGGGHTS. Results obtained for various particulate solids with a hopper system built in our lab are then compared to data from the literature as well as to those from bouncing experiments that depend on the nature of the flat surface used. They reveal that the proposed approach is an efficient way of determining adequately the value of the damping coefficient in the case of particle-particle collisions.