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Abstract.

By means of quasi-2D experiments and 2D numerical tests we investigate the particle flow around a moving intruder immersed into an ensiled granular material. The intruder (a blade) is first positioned at the bottom of a transparent box. The box is filled with glass beads up to a fixed bed height. The intruder is then moved upward at constant velocity. The flow around the intruder is analyzed using a Particle Image Velocimetry (PIV) method, while a force sensor monitors the exerted vertical drag force. In the vicinity of the intruder, avalanches, lateral collapsing, compacted zones, shear banding… are clearly observed. These flow typologies are correlated to successive loading-unloading events in the force signal. As a function of the intruder depth, three flow regimes of the particles can be distinguished: quasistatic, frictional and collisional.
Regarding to numerical simulations, a Discrete Element (DEM) approach was developed to clarify the force transmission at the scale of the contact between particles and with the intruder. Specific boundaries conditions were programed to simulate the geometry of the experimental device, with different sizes of boxes and intruders shapes. The grain flow and the forces acting on the intruder are computed during its ascending motion.
Finally, both experimental and numerical parametric study were performed, in which the velocity of the intruder was varied. Based on these results the experimental and numerical flow regimes are compared and analyzed according to the force networks obtained by the DEM.

Keywords.

Particle flow, intruder, local force, discrete element method, rheophysic of granular media.