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Preliminary 2D numerical modeling of common granular problems

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Granular studies received an increasing interest during the last decade. Many scientific investigations were successfully addressed to acknowledge the ubiquitous behavior of granular matter. We investigate liquid impacts onto granular beds, i.e. the influence of the packing and compaction-dilation transition. However, a physically-based model is still lacking to address complex microscopic features of granular bed response during liquid impacts such as compaction-dilation transition or granular bed uplifts (Wyser et al. in review).
We present our preliminary 2D numerical modeling based on the Discrete Element Method (DEM) using nonlinear contact force law (the Hertz-Mindlin model) for disk shape particles. The algorithm is written in C programming language. Our 2D model provides an analytical tool to address granular problems such as i) granular collapses and ii) static granular assembliy problems. This provides a validation framework of our numerical approach by comparing our numerical results with previous laboratory experiments or numerical works.
Inspired by the work of Warnett et al. (2014) and Staron & Hinch (2005), we studied i) the axisymetric collapse of granular columns. We addressed the scaling between the initial aspect ratio and the final runout distance. Our numerical results are in good aggreement with the previous studies of Warnett et al. (2014) and Staron & Hinch (2005). ii) Reproducing static problems for regular and randomly stacked particles provides a valid comparison to results of Egholm (2007). Vertical and horizontal stresses within the assembly are quite identical to stresses obtained by Egholm (2007), thus demonstating the consistency of our 2D numerical model.
Our 2D numerical model is able to reproduce common granular case studies such as granular collapses or static problems. However, a sufficient small timestep should be used to ensure a good numerical consistency, resulting in higher computational time. The latter becomes critical for large assemblies for which many iterations are needed. Nevertheless, our 2D granular code shows good performance when compared to previous numerical studies.