# Generation of particle packs at high packing ratios for DEM simulations of granular compacts

**Kamila R. Cassares, Eduardo M. B. Campello***

Department of Structural and Geotechnical Engineering, Universy of São Paulo
P.O. Box 61548, 05424-970, São Paulo, SP, Brazil
kamilacassares@usp.br, campello@usp.br

## ABSTRACT

This work presents a simple, fast technique for generating particle packs at high packing ratios aiming at the simulation of granular compacts via the discrete element method (DEM). We start from a random sequence addition particle generation algorithm to generate a "layer" of non-overlapping spherical particles which are let to evolve dynamically in time under the action of "compacting" or "jamming" pseudo forces. A "layer-by-layer" approach is followed to generate multiple layers on top of each other. In the end, highly dense packs with pre-defined bulk shapes and sizes (e.g. rectangles in two dimensions and prisms in three dimensions) are achieved. Following this technique, we construct several sets of packs of a given particle size and perform statistical assessment of the attained densities by computing its mean value, standard deviation and variance. Reliability of the technique for generating more or less repeatable (yet randomly created) dense packs is thus evaluated. Moreover, the influence of inter-particle rolling motion and friction during the compaction stage is assessed to verify whether these physics improve or spoil the quality of the generated packs w.r.t. density and ordering. Two different schemes of "compacting" pseudo forces are tested to identify which one leads to the best results.

To some extent, our technique has connections with the well-known, long-established Lubachevsky-Stillinger algorithm [1], and also with the more recent layer-wise procedure of [2], in the sense that a pseudo dynamics simulation of randomly generated particles is performed to squeeze the particles. But differs from them in that (i) we do not employ particle growth (thus congruent packs are naturally possible), (ii) we consider inter-particle friction with rolling motion in the dynamics of the compacting stage (this is possible since we adopt a DEM description instead of a molecular dynamics one) and (iii) our pseudo jamming forces are of a different nature.

We believe that simple techniques for fast generation of particle packs at high packing ratios are crucial tools for the DEM simulation of granular compacts.

## REFERENCES

[1] B. D. Lubachevsky and F. H. Stillinger, "Geometric properties of random disk packings", *J. Stat. Phys*., **60**, 561-583, (1990).

[2] M. J. Jiang, J. M. Konrad, S. Leroueil, "An efficient technique for generating homogeneous specimens for DEM studies", Comput Geotech, **30**, 579-597 (2003).