Statistical distributions obtained from the compression of monodisperse, soft and frictionless particles

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ABSTRACT

The cyclic compression of several granular systems has been simulated with a molecular dynamics code. All the samples consisted of bidimensional, soft, frictionless and equal-size particles that were initially arranged according to a squared lattice and were compressed by randomly generated irregular walls. In some cases, cohesive forces were also considered through a potential that is explained in base on the capillarity caused by wetting.

The compression protocols can be described by some control variables (volume or external force acting on the walls) and by some dimensionless factors, that relate stiffness, density, diameter, damping ratio and water surface tension to the external forces, displacements and periods. Each protocol, that is associated to a dynamic process, results in an arrangement with its own macroscopic features: volume (or packing ratio), coordination number, and stress; and the differences between packings can be highly significant.

The statistical distribution of the force-moment state of the particles (i.e. the equivalent average stress multiplied by the volume) is analyzed. In spite of the lack of a theoretical framework based on statistical mechanics specific for these protocols, it is shown how the obtained distributions of mean and relative deviatoric force-moment are. Then it is discussed on the nature of these distributions and on their relation to specific protocols.

REFERENCES

[1] I. G. Tejada and R. Jimenez, "Statistical mechanics as guidance to particle-based computational methods" *Engineering Computations*, Vol. 30 Iss: 2, pp.301 - 316 (2013).

[2] I. G. Tejada, "A new statistical mechanics approach to dense granular media" *Physica A*, Vol. 390 Iss: 14, pp.2664 - 2677 (2011).

[1] I. G. Tejada, "Stress phase space for static granular matter". arXiv:1208.0252 [cond-mat.soft] (2013).