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Highly strained mixtures of bidimensional soft and rigid grains: an experimental approach from the local scale

Manuel Cárdenas-Barrantes[a], Jonathan Barés[a*], David Cantor[b], Émilien Azéma[ac], Mathieu Renouf[a]

a. LMGC, Université de Montpellier, CNRS, Montpellier, France
b. Department of Civil, Geological and Mining Engineering, Polytechnique Montréal, Québec, Canada
c. Institut Universitaire de France (IUF), Paris, France

* email : jonathan.bares@umontpellier.fr

Granular matter designates a very large family of systems. As such, they are not always homogeneous and can be composed of grains with very different mechanical properties and shapes. In order to improve the understanding of the behavior of real granular systems, in the experimental study we will present here, we compress 2D bidisperse granular media made of both soft and rigid grains. By means of a recently developed experimental set-up [1], from the measurement of the displacement field we can follow all the mechanical observables of these granular media from the inside of each particle up-to the whole system scale. We are able to detect the jamming transition from these observables and study their evolution deep in the jammed state for packing fractions as high as 0.915. We show the uniqueness of the behavior of such systems, in which way it is similar to purely soft or rigid systems and how it is different from them. This study validates a recently proposed compression model [2], and more generally constitutes the first step toward a better understanding of the mechanical behavior of granular materials that are polydisperse in terms of grain rheology.

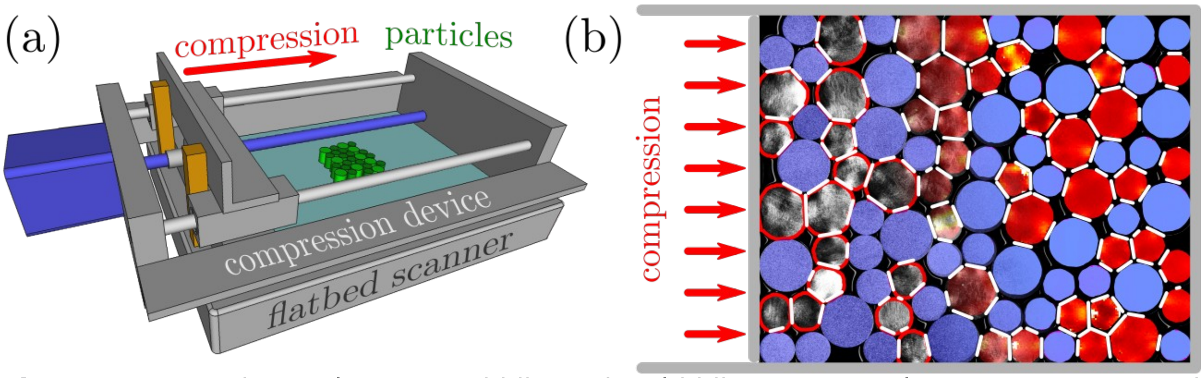

Figure : a: Experimental set-up. A bidimensional bidisperse granular system, composed of soft and rigid particles, lays on the top glass of a flatbed scanner. A uniaxial compression device stresses it stepwisely while it is imaged from below by the scanner. b: Composite view of some measured fields. Rigid particles are colored in blue. Raw image in gray level is shown on the left, particle boundaries are in red. Von Mises strain field is shown on the right hand side with a colorscale going from dark red (low value) to yellow (high value). Contacts are shown on white.

[1] Vu, T. L., & Barés, J. (2019). Soft-grain compression: Beyond the jamming point. *Physical Review E*, *100*(4), 042907.
[2] Cantor, D., Cárdenas-Barrantes, M., Preechawuttipong, I., Renouf, M., & Azéma, E. (2020). Compaction Model for Highly Deformable Particle Assemblies. *Physical Review Letters*, *124*(20), 208003.