Experimental study of highly strained ganular matter

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Abstract

In many situations granular materials are highly stressed and undergo high plastic or hyper-elastic deformations: gauge fault, sintered powders, globules in veins... However, most of the experiments stay in the small deformation regime for theoretical convenience and are not able to properly catch the behaviour of these materials. By mean of a novel experimental approach we overcome the limitations of the photo-elastic method to measure local strain in highly deformed particles.

We built an apparatus capable of compressing a densely packed set of 2D bidisperse discs made of silicone and agar while imaging them very accurately after each loading step. This accurate imaging process permits first to follow precisely the evolution of the particle positions and geometries. Then a homemade Digital Image Correlation code catches the evolution of the displacement fields in each particle. All non-linear elasticity tensors (deformation, Cauchy-Green, strain...) are deduced and open a new field of experimental analysis for 2D granular matter.

We believe this new measurement method, not limited to a specific material, shape or loading mechanism opens a wide panel of new experimental possibility...

Keywords: high strain, compression, image correlation, local field, soft granular matter

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