

Society of Engineering Science 51st Annual Technical Meeting

1–3 October 2014

Purdue University, West Lafayette, Indiana, USA

Imaging forces in a three-dimensional granular material

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ABSTRACT

We experimentally study the quasi-static deformation of a three-dimensional sphere packings subjected to macroscopic deformation. We perform these experiments on slightly polydisperse and nearly frictionless soft hydrogel spheres in a modified triaxial shear apparatus. We resolve the microscopic force and displacement network in a three-dimensional packing through imaging the entire packing at different loading steps. By resolving particle deformations via custom written image analysis software, we extract all particle contacts and contact forces with a very good accuracy. In addition, we measure boundary stresses during compression and shear. We address the non-linear force response of a disordered packing under compression and shear, force network dynamics, and explore the plastic rearrangements inside cyclically sheared and compressed packings.