Crack propagation in wet granular medium

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Abstract

Wet granular materials are able to sustain a tensile load thanks to the cohesion between grains induced by the capillary bridges. When an intruder is pushed in such a material, tensile cracks, like mode 1 cracks in solid materials, can appear. Such cracks are relevant in a variety of context (soil mechanics, powder compaction ...), but have not been studied extensively. We offer a solid mechanics perspective on the issue, focusing on the study of crack propagation within this type of matter to build a model able to predict fracture advancement.
We have designed a procedure to prepare a wet granular pile with a reproducible compaction. Using X-ray tomography, we show that for dense enough material, the overall compaction is homogeneous in our medium. We investigate the threshold compaction value needed to observe cracks, as well as the final crack pattern. Using 3D X-ray microtomography, we can measure the displacement fields, and show that crack nucleation is linked to dilation. We also measure the indentation force, and its dependence on compaction and cohesion level.
These experimental measurements allow us to develop a model to understand the stress-strain relation, and the appearance of cracks.

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