Stress-chains in a triaxial test

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Abstract

Force chains are defined as heterogeneous physical structures that can constrain the mechanical stability of granular materials. Here, stress field within the particle is used to identify load-bearing chains and compared with commonly reported force chains. A recently proposed micro Finite Element (μFE) method that enables the simulation of an assembly of irregular discrete grains is employed (Nadimi & Fonseca, 2018) for the case of a sample of sand under triaxial compression. The numerical results are compared against experimental data obtained from an in-situ test using X-ray micro Computed Tomography (μCT). In this framework, the fabric of the soil sample is imported into the numerical domain and material properties, contact properties and boundary conditions are defined according to the experimental test. The macroscopic response of the numerical simulation is shown to compare well with the experiment. The contact regions are identified based on their ability to transmit stress and the evolution of the contact normals is shown to correlate well with the macro stress evolution. The computed stress fields within each grain are used to identify the load bearing grains in the assembly. A mismatch between the grains carrying the highest force and grains carrying the highest stress was found suggesting the force chain criterion may not be able to demonstrate the mechanical stability of granular materials. Nadimi, S. and Fonseca, J. (2018). A micro finite-element model for soil behaviour. *Géotechnique*, 68(4), pp. 290-302. doi: 10.1680/jgeot.16.P.147

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