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POLYHEDRAL DISCRETE ELEMENT METHOD MODELLING OF NATURAL SAND UNDER UNIAXIAL COMPRESSION

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The study of the mechanical behaviour of granular materials is still to date an open ended research topic. A plethora of analyses have been implemented based on the Finite Element Method, making the assumption of a continuous medium. Yet, in reality the behaviour is dominated by grain to grain contact interactions. The discrete element method has been proven ideal for applications of a discontinuous nature, such as granular flows or jointed rocks. Most DEM studies within the last 40 years have considered either spherical particles or non-spherical ones that are formulated as clumps or clusters of spheres, aiming to achieve modelling simplicity and minimisation of the computational cost, disregarding the interaction of the grains to a micro level.

In this study, the behaviour of an intact natural sand sample is examined under oedometer compression, employing the discrete element method and convex polyhedral particles. The exact geometry of the grains constituting the sample has been derived using micro computed tomography (μCT) [1]. The geometry of the DEM model is generated by applying a novel computer vision algorithm, which facilitates the 3D reconstruction of the particles' faces, given the scan of the sample. The analyses are implemented on the open-source DEM code YADE [2], utilising convex optimisation techniques for the contact detection process amongst the highly irregular polyhedral particles [3]. By variating the level of detail of the particles' geometry in sensitivity analyses, the results from every different level are compared. Conclusions are then drawn on the effect of the level of detail of the geometry on several grain-shape characterisation parameters (e.g. the sphericity and the angularity of grains), on the computational cost and most importantly on the mechanical behaviour of the sample.

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