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# Characterising fabric, force distributions and porosity evolution in sheared granular media

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Active faults, landslides, subglacial tills and poorly or unconsolidated sands essentially contain accumulations of granular debris that evolve under load. Both the macroscopic motions and the bulk fluid flow characteristics that result are determined by the particular grain scale processes operating in this deformed or transformed granular material. A relevant question is how the local behavior at the individual granular contacts actually sums up, and in particular how the load bearing skeleton (an important expression of connected load) and spatial distribution of pore space (and hence fluid pathways) are linked.

Here we investigate the spatial distribution of porosity with granular rearrangements (specifically contact force network characteristics) produced in 3D discrete element models of granular layers under shear. We use percolation measures to identify, characterize, compare and track the evolution of strongly connected contact force networks. We show that specific topological measures used in describing the networks, such as number of contacts and coordination number, are sensitive to grain size distribution of the material as well as loading conditions. In addition we probe the 3D spatial distribution of porosity as a function of increasing strain. Two cases will be considered. The first, a non-fracture regime where configurational changes occur during shear but grain size distribution remains constant. This would be expected for a soil or granular material under relatively low normal loading. Secondly we consider a fragmentation regime where the grain size distributions of the granular material evolve with accumulated strain. This mirrors the scenario for faults or basal shear zones of slides under higher normal stress where comminution is typically a mark of increasing maturity and plays a major role in the poro-perm evolution of the system.

We will present the correlated and anti-correlated features appearing in our simulations as well as discussing the triggers and relative persistence of fluid pathway creation versus destruction mechanisms. We will also demonstrate how the individual grain interactions are manifested in the macroscopic sliding behavior we observe.