Abstract Submitted
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Shear failure of granular materials ERIC DEGIULI, NEIL BALMFORTH, Dept. Mathematics, UBC, JIM MCELWAINE, DAMTP, University of Cambridge, CHRISTIAN SCHOOF, Dept. Earth and Ocean Sciences, UBC, IAN HEWITT, Dept. Mathematics, UBC — Connecting the macroscopic behavior of granular materials with the microstructure remains a great challenge. Recent work connects these scales with a discrete calculus [1]. In this work we generalize this formalism from monodisperse packings of disks to 2D assemblies of arbitrarily shaped grains. In particular, we derive Airy's expression for a symmetric, divergence-free stress tensor. Using these tools, we derive, from first-principles and in a mean-field approximation, the entropy of frictional force configurations in the Force Network Ensemble. As a macroscopic consequence of the Coulomb friction condition at contacts, we predict shear failure at a critical shear stress, in accordance with the Mohr-Coulomb failure condition well known in engineering. Results are compared with numerical simulations, and the dependence on the microscopic geometric configuration is discussed.

[1] E. DeGiuli & J. McElwaine, PRE 2011. doi: 10.1103/PhysRevE.84.041310

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