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Force heterogeneity and stress propagation inside 3D granular materials

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The effect of increasing structural disorder on the (re)distribution of contact stresses inside three dimensional particle assemblies is systematically studied using computer simulations of granular packings. Starting from a face-centred cubic array, where all contact forces are identical, particles are removed at random and the system is then allowed to relax into a new mechanically stable state. Various measures are used to quantify the amount of disorder, including distributions of the coordination number, three-particle contact angle, and normal contact forces. Upon applying a localised, perturbative force within the central region of the packings, the resulting stress response is mapped inside the different particle assemblies, covering several orders of magnitude in the particle friction coefficient. There is a clear change in the propagative response between frictionless and highly-frictional packings, with an intermediate, crossover regime for packings with lower values of the friction coefficient.