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Simulations of Shear Jamming in Packings of Frictionless and Frictional Particles[1]

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We recently proposed a theoretical framework for predicting the protocol dependence of the jamming transition for frictionless spherical particles that interact via repulsive contact forces. We studied isostatic jammed disk packings obtained via two protocols: isotropic compression and simple shear. We showed that for frictionless systems, all jammed packings can be obtained via either protocol. We predicted the average shear strain required to jam initially unjammed isotropically compressed packings from the density of jammed packings, shape of their basins of attraction, and path traversed in configuration space. We compared our predictions to simulations of shear strain-induced jamming and found quantitative agreement. Finally, we showed that the packing fraction range, over which shear strain-induced jamming occurs, tends to zero in the large system limit for frictionless packings with overdamped dynamics. Here, we extend this theoretical framework to packings of frictional disks using two models for friction: the Cundall-Strack and geometric asperity models. We measure the applied shear strain required to jam originally unjammed packings as a function of the static friction coefficient and system size. In addition, we compare the stress and fabric anisotropies of packings obtained from the isotropic compression and shear protocols to identify macroscale properties that distinguish the packings.

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