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Lattice model of correlated forces in granular solids near jamming

JING CAO, Penn state University, JILLIAN NEWHALL, University of Illinois, SCOTT MILNER, Penn state University — We have devised a lattice model to study force correlations in granular solids as the isostatic limit is approached. We apply biased Monte Carlo simulations to the Tighe "wheel move" model to progressively starve the system of force-bearing bonds. Increasingly long-ranged correlations are visible as point J is approached, not in the structure of the network of force-bearing bonds, but in the spatial extent of perturbations of the forces consistent with a given starved network. The correlation length so defined diverges as the isostatic point is approached, as a power law $\xi = \delta Z^{-4.78}$. This divergence is much stronger than for the length scale of "soft modes" observed in jammed systems approaching point J from above. We can relate the correlated regions we observe to a certain definition of percolation clusters. The probability distribution of cluster sizes, and the bulk and surface fractal dimensions of the clusters, all scale analogously to classical percolation, but with distinctly different scaling exponents.

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