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Rigidity Transition: From Random Networks To Jamming[1]

VARDA FAGHIR HAGH, Department of Physics, Arizona State University, M.F. THORPE, Department of Physics, Arizona State University; Rudolf Peierls Centre for Theoretical Physics, University of Oxford — We study the qualitative differences in the rigidity transition of three types of disordered networks: randomly diluted spring networks, stress-relieved networks obtained by diluting the stressed bonds and disk packing networks. Unlike randomly diluted networks the transition points of stress-relieved and jammed networks are globally isostatic. However they behave very differently when we add/remove one bond to/from their isostatic state. We introduce two new indices h and s that measure the average fractions of hinges and stressed bonds that appear as we remove or add one bond to the isostatic state of the networks. These indices characterize the high degree of self-organization at the jamming point where global changes occur by adding or removing only one bond. We then incorporate a new condition into stress-relieved networks, where at each site we insist that the Hilbert stability condition is obeyed. The Hilbert condition involves having at least three contacts at each site, with at least one contact in every semicircle. This introduces an isostatic state with a unique structure of Laman sub-graphs identical to the Laman sub-graphs of jamming that has similar h and s indices and exposes the underlying geometrical self-organization of jammed networks.

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