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Control and large deformations of marginal disordered structures
ARVIND MURUGAN, MATTHEW PINSON, University of Chicago, ELIZABETH CHEN, Harvard University — Designed deformations, such as origami patterns, provide a way to make easily controlled mechanical metamaterials with tailored responses to external forces. We focus on an often overlooked regime of origami - non-linear deformations of large disordered origami patterns with no symmetries. We find that practical questions of control in origami have counterintuitive answers, because of intimate connections to spin glasses and neural networks. For example, 1 degree of freedom origami structures are actually difficult to control about the flat state with a single actuator; the actuator is thrown off by an exponential number of 'red herring' zero modes for small deformations, all but one of which disappear at larger deformations. Conversely, structures with multiple programmed motions are much easier to control than expected - in fact, they are as easy to control as a dedicated single-motion structure if the number of programmed motions is below a threshold ('memory capacity').

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