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Triggered Snap-Through of Bistable Shells[1] YIJIE CAI, Wuhan University of Technology, SHICHENG HUANG, IAN TRASE, NAN HU, ZI CHEN, Dartmouth College — Elastic bistable shells are common structures in nature and engineering, such as the lobes of the Venus flytrap or the surface of a toy jumping poppers. Despite their ubiquity, the parameters that control the bistability of such structures are not well understood. In this study, we explore how the geometrical features of radially symmetric elastic shells affect the shape and potential energy of a shell's stable states, and how to tune certain parameters in order to generate a snap-through transition from a convex semi-stable state to concave stable state. We fabricated a series of elastic shells with varying geometric parameters out of silicone rubber and measured the resulting potential energy in the semi-stable state. Finite element simulations were also conducted in order to determine the deformation and stress in the shells during snap-through. It was found that the energy of the semi-stable state is controlled by only two geometric parameters and a dimensionless ratio. We also noted two distinct transitions during snap-through, one between monostability and semi-bistability (the state a popper toy is in before it snaps-through and jumps), and a second transition between semi-bistability and true bistability. This work shows that it is possible to use a set of simple parameters to tailor the energy landscape of an elastic shell in order to generate complex trigger motions for their potential use in smart applications.

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