Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Bi-stable characteristics of thick-walled domes with applications to soft material snapping AMIT MADHUKAR, UIUC — Bi-stable structures can exhibit interesting mechanical properties which makes them the focus of research in the field of extreme mechanics. Fast transitions can occur between equilibrium states with very little actuation force. One such bi-stable structure is the thick-walled dome. In this work, we apply finite element techniques to examine the stability of such spherical, thick-walled domes undergoing large deformation. We apply the following methods to two structures: a single-layered system as well as bi-layered colloidal microparticles which actuate through pH driven mismatched swelling. The presence of a metastable state is identified by the energy characteristics alone. Monotonically increasing energy represents a mono-stable structure. Bi-stability occurs when we achieve a local energy minimum at some non-zero displacement. Of more interest is the region near the transition of these states where we find a so called pseudo-bi-stable state where small perturbations results in fast transition from the elevated energy state, or snapping. We use our simulations to map out the critical geometric parameters that govern this behavior in order to design a dome to snap. Experimental results are used to validate the simulation results.

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Date submitted: 14 Nov 2014 Electronic form version 1.4