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Design of Multistable Origami Structures[1] ANDREW GILLMAN, UES, Inc., KAZUKO FUCHI, University of Dayton Research Institute, GIORGIO BAZZAN, UES, Inc., GREGORY REICH, EDWARD ALYANAK, PHILIP BUSKOHL, Air Force Research Laboratory — Origami is being transformed from an art to a mathematically robust method for device design in a variety of scientific applications. These structures often require multiple stable configurations, e.g. efficient well-controlled deployment. However, the discovery of origami structures with mechanical instabilities is challenging given the complex geometric nonlinearities and the large design space to investigate. To address this challenge, we have developed a topology optimization framework for discovering origami fold patterns that realize stable and metastable positions. The objective function targets both the desired stable positions and nonlinear loading profiles of specific vertices in the origami structure. Multistable compliant structures have been shown to offer advantages in their stability and efficiency, and certain origami fold patterns exhibit multistable behavior. Building on this previous work of single vertex multistability analysis, e.g. waterbomb origami pattern, we are expanding the solution set of multistable mechanisms to include multiple vertices and a broader set of reference configurations. Collectively, these results enable an initial classification of geometry-induced mechanical instabilities that can be programmed into active material systems.

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