Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Optimization of Actuating Origami Networks[1] PHILIP BUSKOHL, Air Force Research Laboratory, KAZUKO FUCHI, Wright State Research Institute, GIORGIO BAZZAN, JAMES JOO, REICH GREGORY, RICHARD VAIA, Air Force Research Laboratory — Origami structures morph between 2D and 3D conformations along predetermined fold lines that efficiently program the form, function and mobility of the structure. By leveraging design concepts from action origami, a subset of origami art focused on kinematic mechanisms, reversible folding patterns for applications such as solar array packaging, tunable antennae, and deployable sensing platforms may be designed. However, the enormity of the design space and the need to identify the requisite actuation forces within the structure places a severe limitation on design strategies based on intuition and geometry alone. The present work proposes a topology optimization method, using truss and frame element analysis, to distribute foldline mechanical properties within a reference crease pattern. Known actuating patterns are placed within a reference grid and the optimizer adjusts the fold stiffness of the network to optimally connect them. Design objectives may include a target motion, stress level, or mechanical energy distribution. Results include the validation of known action origami structures and their optimal connectivity within a larger network. This design suite offers an important step toward systematic incorporation of origami design concepts into new, novel and reconfigurable engineering devices.

[1]This research is supported under the Air Force Office of Scientific Research (AFOSR) funding, LRIR 13RQ02COR.

Philip Buskohl
Air Force Research Laboratory

Date submitted: 14 Nov 2014 Electronic form version 1.4