Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Origami Optimization: Role of Symmetry in Accelerating Design[1] PHILIP BUSKOHL, Air Force Research Laboratory, KAZUKO FUCHI, Wright State Research Institute, GIORGIO BAZZAN, UES, Inc, MICHAEL DURSTOCK, GREGORY REICH, JAMES JOO, 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. Design optimization tools have recently been developed to predict optimal fold patterns with mechanics-based metrics, such as the maximal energy storage, auxetic response and actuation. Origami actuator design problems possess inherent symmetries associated with the grid, mechanical boundary conditions and the objective function, which are often exploited to reduce the design space and computational cost of optimization. However, enforcing symmetry eliminates the prediction of potentially better performing asymmetric designs, which are more likely to exist given the discrete nature of fold line optimization. To better understand this effect, actuator design problems with different combinations of rotation and reflection symmetries were optimized while varying the number of folds allowed in the final design. In each case, the optimal origami patterns transitioned between symmetric and asymmetric solutions depended on the number of folds available for the design, with fewer symmetries present with more fold lines allowed. This study investigates the interplay of symmetry and discrete vs continuous optimization in origami actuators and provides insight into how the symmetries of the reference grid regulate the performance landscape.

[1]This work was supported by the Air Force Office of Scientific Research.

Philip Buskohl
Air Force Research Laboratory

Date submitted: 06 Nov 2015 Electronic form version 1.4