Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Auto-Origami and Soft Programmable Transformers: Simulation Studies of Liquid Crystal Elastomers and Swelling Polymer Gels ANDREW KONYA, Kent State University, CHRISTIAN SANTANGELO, University of Massachusetts Amherst, ROBIN SELINGER, Kent State University — When the underlying microstructure of an actuatable material varies in space, simple sheets can transform into complex shapes. Using nonlinear finite element elastodynamic simulations, we explore the design space of two such materials: liquid crystal elastomers and swelling polymer gels. Liquid crystal elastomers (LCE) undergo shape transformations induced by stimuli such as heating/cooling or illumination; complex deformations may be programmed by "blueprinting" a non-uniform director field in the sample when the polymer is cross-linked. Similarly, swellable gels can undergo shape change when they are swollen anisotropically as programmed by recently developed halftone gel lithography techniques. For each of these materials we design and test programmable motifs which give rise to complex deformation trajectories including folded structures, soft swimmers, apertures that open and close, bas relief patterns, and other shape transformations inspired by art and nature. In order to accommodate the large computational needs required to model these materials, our 3-d nonlinear finite element elastodynamics simulation algorithm is implemented in CUDA, running on a single GPU-enabled workstation.

Andrew Konya
Kent State University

Date submitted: 14 Nov 2013 Electronic form version 1.4