Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

A probabilistic approach to randomness in geometric configuration of scalable origami structures KE LIU, GLAUCIO PAULINO, PAOLO GARDONI, University of Illinois at Urbana-Champaign — Origami, an ancient paper folding art, has inspired many solutions to modern engineering challenges. The demand for actual engineering applications motivates further investigation in this field. Although rooted from the historic art form, many applications of origami are based on newly designed origami patterns to match the specific requirenments of an engineering problem. The application of origami to structural design problems ranges from micro-structure of materials to large scale deployable shells. For instance, some origami-inspired designs have unique properties such as negative Poisson ratio and flat foldability. However, origami structures are typically constrained by strict mathematical geometric relationships, which in reality, can be easily violated, due to, for example, random imperfections introduced during manufacturing, or non-uniform deformations under working conditions (e.g. due to non-uniform thermal effects). Therefore, the effects of uncertainties in origami-like structures need to be studied in further detail in order to provide a practical guide for scalable origami-inspired engineering designs. Through reliability and probabilistic analysis, we investigate the effect of randomness in origami structures on their mechanical properties. Dislocations of vertices of an origami structure have different impacts on different mechanical properties, and different origami designs could have different sensitivities to imperfections. Thus we aim to provide a preliminary understanding of the structural behavior of some common scalable origami structures subject to randomness in their geometric configurations in order to help transition the technology toward practical applications of origami engineering.

Ke Liu
University of Illinois at Urbana-Champaign

Date submitted: 14 Nov 2014 Electronic form version 1.4