PennState College of Engineering

Systems, Controls, and Robotics Seminar Series

Adaptable Origami Structures at Multiple Scales

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ABSTRACT

Folding of thin sheets based on the principles of origami can create a rich variety of deployable, reconfigurable, and mechanistically tunable three-dimensional structures. This talk we will present my group's work on exploring the mechanics of origami with the aim of enabling functional shape-morphing and adaptation at multiple scales. We first discuss our work on creating reduced-order analytical models that allow for rapid simulation of origami mechanics. These models are then used to explore some unique origami designs that possess unusually high stiffness-to-weigh ratios, including: self-restraining deployable origami tubes; hexagonal dome-like origami; and curved crease corrugations with multidirectional stiffness. Next, we discuss approaches for practical realization and fabrication of origami at multiple-scales. At large scales, we explore folding systems consisting of rigid panels and hinges, while at the micro-scale we use photolithography techniques to fabricate functional electro-thermal micro-origami. The fundamental principles discussed in our talk are relevant to a variety of deployable and adaptable structures include metamaterials, biomedical micro-robotics, deployable satellites, reconfigurable architecture, and more.

BIOGRAPHY

Evgueni Filipov is an Associate Professor in the Department of Civil and Environmental Engineering and the Department of Mechanical Engineering at the University of Michigan, Ann Arbor. His research interests are focused on the underlying mechanics of origami-inspired deployable and reconfigurable structures. These mechanics are employed to improve stiffness, functionality, and manufacturing of the folded systems. He holds M.S. and Ph.D. degrees in Civil Engineering from the University of Illinois at Urbana-Champaign, and a B.S. from Rensselaer Polytechnic Institute. He has received the ASCE EMI Leonardo da Vinci Award (2023), the NSF CAREER Award (2020), the DARPA Young Faculty Award (2018), the Cozzarelli Prize from the National Academy of Sciences (2015), and the NSF Graduate Research Fellowship. Learn more about his research at his lab's website: http://drsl.engin.umich.edu/systems.