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# Kresling Origami-Inspired Multistable Composites for Shape Reconfiguration

Jun Cai[1,2], Hamid Akbarzadeh[2,3*], David Mélançon[1*]
[1]Department of Mechanical Engineering, Polytechnique Montréal, Montréal, Canada
[2]Department of Bioresource Engineering, McGill University, Montréal, Canada
[3]Department of Mechanical Engineering, McGill University, Montréal, Canada
* hamid.akbarzadeh@mcgill.ca and david.melancon@polymtl.ca

ABSTRACT

Composite materials used in structural components of aircraft and space systems are lightweight and load-bearing, but their static nature limits their adaptability to drastic environmental changes, such as those encountered during different flight phases or the abrupt transition from day to night in space. To address this limitation, we present a study on bistable Kresling origami units that offer programmable mechanical properties and shape-morphing capabilities. Using finite element method (FEM), we simulate their mechanical response and demonstrate how tuning geometrical parameters (e.g., hinge width and thickness) and the stiffness between hinges and panels can alter the structural stability condition of the Kresling origami. Furthermore, by adopting the shape memory behavior and the mismatch in temperature-dependent moduli of two polymeric materials used for forming the constitutive hinges and panels, we explore temperature-controlled actuation for shape morphing and fine-tuning the mechanical responses. Inspired by these findings, we develop sandwich-structured composites with cores composed of Kresling origami units characterized by different geometrical parameters, enabling surface shape morphing in response to environmental temperature changes. Our study not only provides a novel solution for adaptive composite structures but also reduces the need for additional actuation systems, offering a lightweight and integrated alternative for aerospace applications.