

Mechanical characterization of an engineered origami structure : toward self-actuation of a bistable seamless Kresling tower

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Abstract

Origami inspired robot is a local motion machine whose morphology and operations are created by self-folding. The origami panel's bending, stretching, and shearing provide tunable stiffness and additional degrees of freedom to the robot body. Especially, structures inspired by 'Kresling tower' that exhibit a translation-rotation coupled motion with a hysteretic & bistable behavior earned attention in the last decades. These structures can provide local motion and multistability. Most of the current research work on this topic are usually performed using paper, which is easy to be folded but exhibit very weak properties in term of shear stress, and can be easily teared. In this work, an experimental investigation on an engineered structure to be used as part of the robot body is presented. More specifically, the study aims at characterizing the necessary torque for self shape-morphing of a Kresling pattern-based seamless origami structure in polypropylene (PP).

To this end, two types of tests are cyclically performed : compression-tensile load under free torque conditions (C-T, 50 cycles) and vice versa (C-AC, 300 cycles). A training of the structure is required before reaching a stabilized structure's behavior. The PP-based seamless Kresling tower unit exhibits a hysteretic behavior that is combined by a mono-stable and a bi-stable behavior. The structure provides a coupling between translation and rotation in a quasi-linear manner. The experimental setup provides very repeatable results and the torque required for the folding of the structure are found. On-going work is focused on the design of a SMA-based actuation of the bistable seamless Kresling tower.

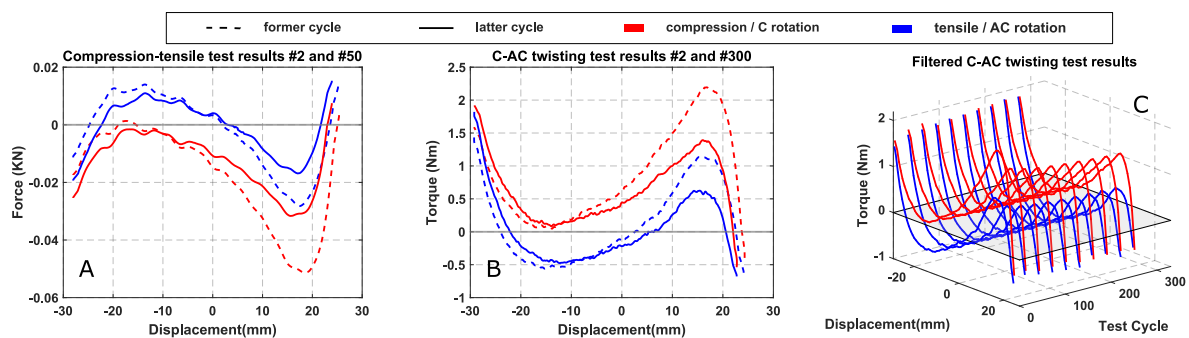


FIGURE 1 – Mechanical responses for two types of tests : A) C-T test for 50 cycles B) & C) C-AC test for 300 cycles

Mots clefs : characterization, non-rigid origami, shape-morphing, actuation

Références

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