Sculpting structures and solids through shearing, folding, and vibration

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Abstract

During the process of folding, curvature localizes in space and progressively forms sharp edges, separated by almost undeformed elements. Origami is created by inducing folding in thin films, which can be made from paper or other materials. Differently from the creation of origami, folding in rock formations, marine shells, or other natural elements is a spontaneous process, driven by forces and, for living matter, growth. The purpose of the presentation is to develop the modelling of spontaneous folding in structures (Fig. 1) and solids [1, 2]. In an analogous vein, during the spontaneous emergence of deformation bands, strain localizes, to create stress channelling and wave trapping. A new homogenization scheme is presented to show that a metamaterial can be designed to exhibit shear band formation followed by restabilization and final ellipticity loss under radially increasing load [3].

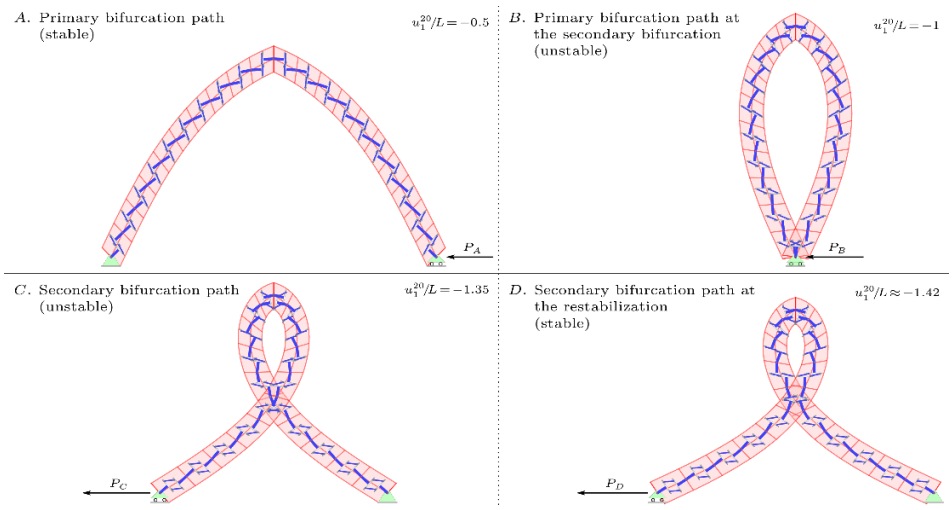

Figure 1. Folding formation during the postcritical path of a doubly-supported microstructured rod.

The obtained results can be applied to various technological contexts involving highly compliant mechanisms, such as the achievement of objective trajectories with soft robot arms through folding and localized displacement of origami-inspired or multi-material mechanisms.

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References

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