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Deployable structures based on surfaces with controlled stretching and shearing: from biological templates to 3d-printed prototypes

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Abstract

Motile biological organisms have solved the problem of controlling shape and adapting shape to function with clever designs elaborated by nature through evolution and natural selection. Structural forms inspired by biological organisms are also adaptable, plastic, and morphable, and they offer inspiration for innovative deployable structures. In this contribution, we will report on our findings concerning the morphing mechanisms achievable by constructing an active surface made of parallel flexible strips which are capable of sliding along their common edges. These mechanisms are inspired by the cell wall structure of Euglenids, a family of unicellular protists capable of modulating their body shapes through peristaltic waves [1-3]. We will show how the spatial modulation of the sliding between adjacent strips enables these structures to achieve a wide variety of shapes, and how shape changes are associated with the reconfigurations of the strips, which adopt remarkable helical patterns [4]. We will present the mechanics that govern the shape control of these novel shape-shifting shells and their physical implementation using 3D printing.

References

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