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Euglena surfaces: morphing structures inspired by the motility of unicellular organisms

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Abstract

Bio-inspired structural forms are interesting for the aesthetic appeal of biomorphic shapes and for functional reasons associated with clever designs elaborated by nature through evolution and natural selection. Often structural forms inspired by biological organisms are also adaptable, plastic, and morphable. In this contribution, we will report on our findings concerning the mechanisms allowing the amoeboid motion in Euglenids, a family of unicellular protists capable of modulating their body shapes through peristaltic waves. These cells are capable of harmoniously modulating their shape thanks to the unique architecture of their envelope, which consists of juxtaposed long and flexible strips connected by molecular motors that keep them together and allow them to actively slide past each other [1,2]. We will show how the spatial modulation of the sliding between adjacent strips allows these cells to achieve a wide variety shapes, and how shape changes require reconfigurations of the strips, which adopt remarkable helical patterns. Furthermore, we will show how the principle underlying the deformable envelope of Euglena cells can be abstracted from the biological context, and used to build "Euglena structures", which strike a delicate balance between morphability and structural rigidity. We will present the mechanics that govern the shape control of these systems [3] and their physical implementation using 3D printing.

References

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