

Design and Construction of an Origami-inspired Shell Structure

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Abstract

Deployable shell structures are often considered for temporary shelters [1]. For such applications the shell structure needs to have the following properties: (1) low self-weight (preferably portable by one person); (2) small packaged volume; (3) easily deployed (without the use of heavy lifting devices). It has been shown that origami has great potential for designing structures with those properties [1, 2]. Here we enlarge the range of possible design by considering new variations of rigid-foldable quadrilateral creased papers [3].

In this paper, we will describe the use of a recently developed category of rigid-foldable quadrilateral crease pattern in the design of such shell structures. The creased papers considered are not flat-foldable, nor do they use special crease patterns based on several parallel straight-lines. However, the rigid folding motion still only has one degree of freedom. An example is shown in Figure 1.

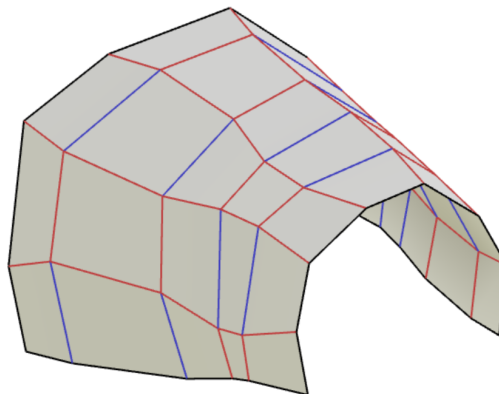


Figure 1: An example of a shell structure designed using a new rigid-foldable quadrilateral crease pattern. It can be folded from the flat state, and the rigid folding motion has only one degree of freedom. Here two opposite boundary components approximate two arcs with different radius.

References

- [1] A. P. Thrall and C. P. Quaglia. Accordion shelters: A historical review of origami-like deployable shelters developed by the US military, *Engineering structures*, vol. 59, pp. 686–692, 2014.
- [2] T. Tachi. Freeform rigid-foldable structure using bidirectionally flat-foldable planar quadrilateral mesh, *Advances in architectural geometry*, pp. 87–102, 2010.
- [3] Z. He and S.D. Guest. On Rigid Origami II: Quadrilateral Creased Papers, *arXiv preprint arXiv:1804.06483*, 2018.