Equilibrium and self-stress of rigid origami structures

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Keywords: rigid origami, self-stress

In recent years, origami-inspired structures have been the subject of numerous studies for various applications (see, e.g., [1] and the literature cited therein). Here we focus on structures composed by rigid polygonal plates hinged to each other at their edges. In particular, we consider internal stresses exchanged between adjacent plates, and we write down equilibrium conditions of the whole system. We show that these structures, other than having one or more internal mechanisms [2], also present several states of self-stress, which are rarely taken into account in the literature. In this work we determine the self-stress state of simple origami patterns in different configurations, in order to understand its effects on the strength of physical origami realizations. In addition, we investigate possible strategies to reduce the number of independent self-stresses, or to bring it to zero, by removing some of the connections between plates. This work constitute a first step toward the analytical determination of actual stresses of origami structures under load, in order to establish design criteria for their practical realization.

References

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