An Efficient Form-Finding Procedure for Tensegrity Structures with Rigid Cores

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Abstract

Tensegrity structures are typically composed of a set of compressive elements (called struts) floating within a network of tensile elements (called cables). In conventional models, struts need to be disjoint and their colliding is not normally allowed in the final form. However, there is a class of tensegrity structures that contain one or more rigid cores in their configurations. Clearly, since these cores have predefined geometries and can only undergo the rigid motions within the form-finding procedure, they might not be modelled using freely separate struts. In this paper, we propose an efficient method for the form-finding of tensegrity structures with some rigid core in their configurations. After a brief review of the state of the art of the form-finding methods, a viable formulation and an efficient numerical procedure are presented to solve this particular form-finding problem. The well-known force density method is adopted throughout the paper and is improved to be compatible with this kind of tensegrities. Furthermore, the optimization based methods are investigated and suitable approaches within those methods are also suggested to tackle this problem. Three numerical examples are presented and extensively studied to demonstrate the efficiency of our method in terms of generality, simplicity and accuracy. The results are also compared and contrasted with the available numerical or analytical results. The investigation verifies the feasibility of our method and provides a systematic technique for the form-finding of two and three-dimensional tensegrity structures with rigid cores.

References

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