

# A structural optimisation approach for bistable deployable scissor structures

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## Abstract

Bistable deployable scissor structures can be designed to be transportable and can easily be transformed between two stable states, the compact and the deployed state, offering a huge volume expansion. In the deployed state they instantaneously offer some structural stability as a consequence of an intended snap-through behaviour during transformation, generated by designed geometric incompatibilities [1]. The design of such structures is ideally based on the duality of taking into account both their nonlinear transformation phase, as well as their service state in the deployed configuration, with opposing requirements [2]. During transformation the peak force - and snap-through magnitude - needs to be minimized to obtain an easily transformable structure, while in the deployed state, the stiffness of the structure should be high enough to allow sustaining gravity loads - related to a high snap-through magnitude. In this contribution the computational design based on these opposing trends is formulated as a multi-objective optimisation approach using an evolutionary algorithm. The objectives are the minimisation of the peak force during transformation, as well as of the deflection in the deployed state of a bistable module as a function of selected design parameters.

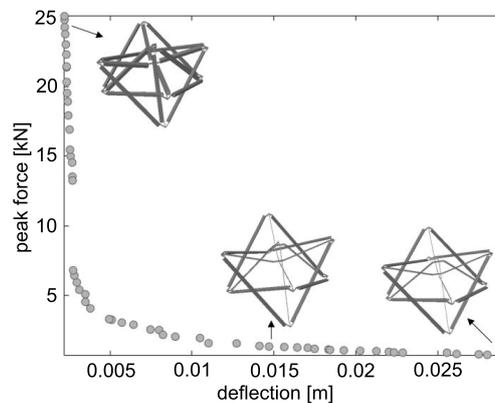


Figure 1: An example of optimisation of a bistable scissor module.

## References

- [1] L. I. W. Arnouts, T. J. Massart, N. De Temmerman and P. Z. Berke, Computational modelling of the transformation of bistable scissor structures with geometrical imperfections, *Engineering Structures*, vol. 177, pp. 409-420, 2018.
- [2] C. J. Gantes, J. J. Connor and R. D. Logcher, A Systematic Design Methodology for Deployable Structures, *International Journal of Space Structures*, vol. 9(2), pp. 67-86, 1994.