# Stochastic Analysis of an Exotic Deployable Space Truss System

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## Summary

In this article a novel exotic, cylindrical, deployable truss system is presented, whose deployment pattern is uncertain because of the different bifurcation paths of its force-displacement diagram. However, the nonlinear analysis of the structure has revealed that this pattern is chaotic though, but not completely stochastic. In fact, the possible deployment patterns ─ corresponding to the different parametric/geometric settings ─ are governed by difficultly determinable rules, resulting in regularities of the patterns resembling the fractal shapes derived from the Mandelbrot set.

Besides its fascinating structural behaviour, and the numerical challenge of its simulation due to its highly nonlinear behaviour, the antiprismatic cylindrical structure may be attractive for artists, architects and structural/mechanical engineers working in the field of flexible systems.

**Keywords:** deployable structures, large displacements, nonlinear analysis, flexible structures, nonlinear instability

## 1. Introduction

The cylindrical deployable pop-up mast, first offered by Hegedus [1], is rendered packable by stretchable hoop strut circles. Its basic unit formed by a truss system with bars placed on the edges of two regular superposed antiprisms (Fig. 1a). The basic unit can be theoretically packed to plain (if the dimension of the structure is not taken into account) by stretching the elastic bars of the inner polygon. By superposing this basic unit, a deployable mast is formed (Fig. 1b). It was shown in [2], that by axially pushing the structure (Fig 1b), the packing pattern of the mast is governed by the

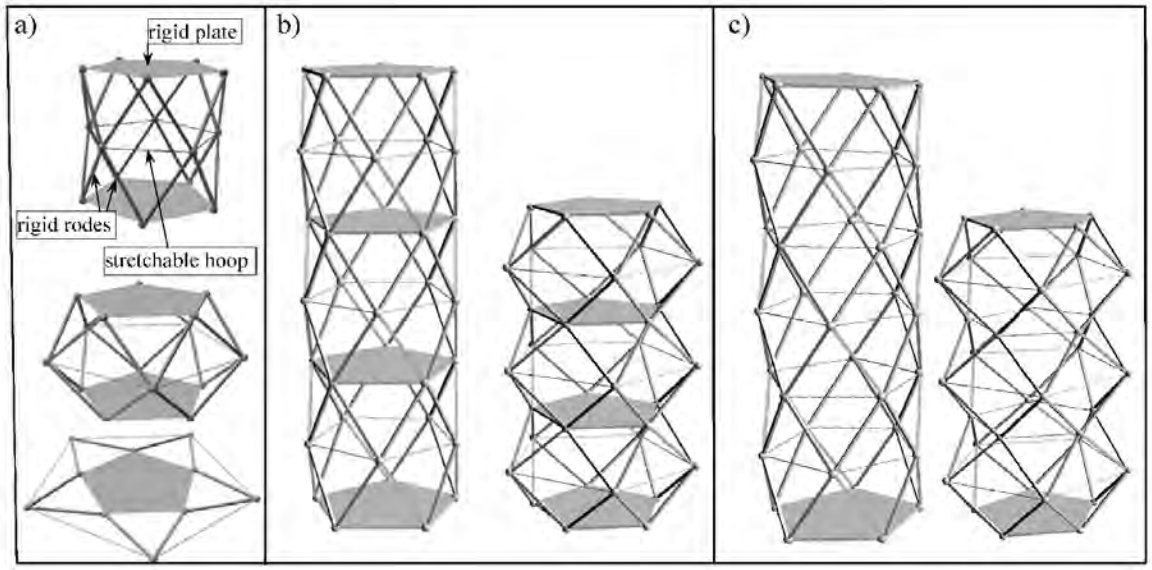


*Fig. 1: a) basic unit b) original pop-up mast c) mast without inner stiffening*

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