Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Mechanics & Materials Laboratory
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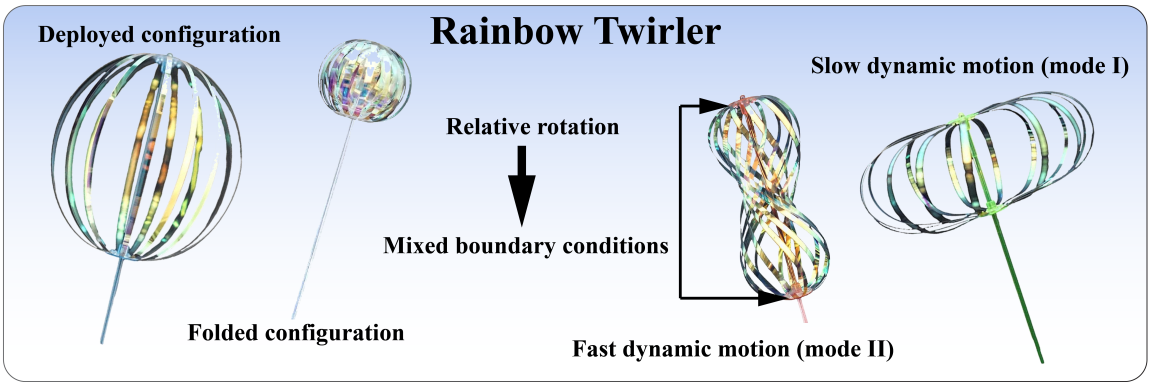
Bachelor's Thesis/Master's Thesis/Semester Project

Experimental study of lightweight deployable structures under rotational actuation



Background: Deployable structures, which drastically change their form and size, are receiving significant attention due to their vast and versatile applications, as for example in the space industry. Space structures are typically deployed into large volumes in their operational configuration, while they are required to pack into small volumes during transport due to the limited storage capacity in space shuttles. With this comes the challenge of unfolding the different structures from their low volume configuration into their operational state while utilizing minimum energy and a minimal amount of actuators.

Project description: The ultimate goal of this project is to experimentally study the behavior of structures which are inspired by the "Rainbow-Twirler". These are cyclic structures composed of nonlinear beams, which are subjected to a single degree of freedom rotational actuation, which applies combined torsion and bending to the beams. Due to these unique boundary conditions, these structures show bistability, resulting in a distinct packed, and deployed configuration.

We will begin by designing and manufacturing a simple experimental demonstrator to shed light onto the physical mechanism providing these structures their bistability. Next, we will investigate the effect of different beams with isotropic and anisotropic cross-sections on the overall behavior of the structures, focusing on their stable configurations. Lastly, with the support of our in-house nonlinear beam code, we will look into structural components with graded cross-sections, with the ultimate goal to develop an optimization pipeline, striving to inverse design structures with programmable stable configurations.

Pre-requisites:

- Strong interest in the mechanics of solids and structures
- A working knowledge of experimental mechanics and instrumentation is helpful but not necessary
- Experience in image processing is desirable but not necessary

For more information, please contact:

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