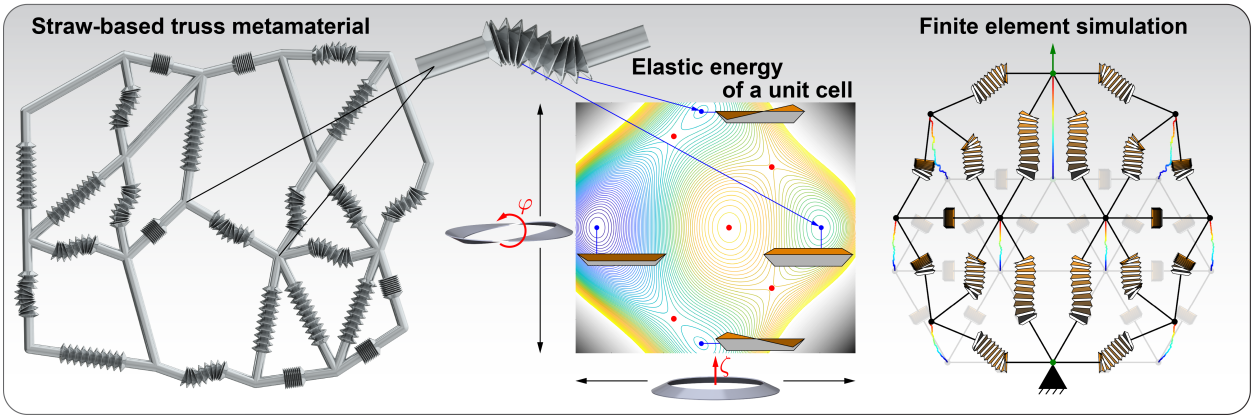
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Mechanics & Materials Laboratory
Prof. Dr. Dennis M. Kochmann
www.mm.ethz.ch

Master's Thesis

Computational modelling and optimization of "Bendy-straw" based truss metamaterials



Description:

Reconfigurable metamaterials whose shapes and properties can be tailored thanks to the multistability of their constituent unit cells, have attracted significant attention due to their unique characteristics. For example, hierarchical structures composed of repeated bistable elements show extreme properties such as large elastic deformations with zero Poisson's ratio, as well as multiaxial complex stable states. Such properties have cross-disciplinary importance and they can be vital for a large variety of applications spanning from deployable structures and soft robots to shock absorption.

Our ongoing research deals with planar truss metamaterials, whose members are modelled as "bendy-straws" which are characterized by local multistability. Namely, under suitable design parameters each constituent segment of every straw has four stable equilibria, which provide a straw-based truss metamaterial, a myriad of stable configurations. Thus, a careful design of such metamaterials can lead to a structures with different operative stable configurations.

This Project involves developing a numerical scheme describing the quasistatic behavior "bendy-straw" based truss metamaterials. This scheme will be implemented utilizing the Mechanics & Materials lab's FE (finite element) interface, starting at the unit cell's level, through the straw scale, up to the modelling of an entire truss metamaterial. The next stage will deal with exploiting the FE code for structural optimization, while examining the effects of the straws' internal physical and geometrical parameters, as well as their arrangement in the truss level.

Pre-requisites:

Interested students should have background in computational mechanics, as well as strong code literacy. Previous experience with C++ is required.

For more information, please contact:

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