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Institut für Technische Mechanik (ITM)
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Prof. Dr.-Ing. Alexander Fidlin
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Mechanics Colloquium

Referent: Dr. Dotan Ilssar / ETH Zürich, Mechanik und Materialforschung

Datum: 02.11.2023
Uhrzeit: 15:45 – 17:15 Uhr
Ort: 10.81 Emil Mosonyi-Hörsaal (HS 62)

Titel: **Mechanics of Straw-Based Truss Metamaterials**

Abstract

A careful design of truss metamaterials considering the geometrical and physical properties of their constituent members as well as their arrangement, can lead to superior structural performance such as exceptional strength-to-weight ratios and tailored anisotropy. However, the behavior of these lattices is typically predetermined and cannot be changed without introducing irreversible plastic deformations. To enrich the nonlinear characteristics achievable by truss metamaterials and allow post-production change of shape and properties, we introduce novel members inspired by drinking straws. In the planar case discussed here, these members are modelled as serial interconnections of unit cells which can be stabilized in two axisymmetric configurations as well as two bent states. These multiaxial equilibria provide the multistable members and the lattices they form with a myriad of multiaxial stable configurations, a vital capability for shape morphing and deployable structures. The large number of stable configurations further allows changing the local stiffness and density of the lattices, which results in programmable static and dynamic properties.

We introduce a numerical scheme describing the mechanical behavior of planar truss metamaterials that incorporate straw-inspired members, considering their multistability as well as the nonlinear holonomic constraints they introduce to the nodes of the truss. This formulation spans a wide design space allowing to change the arrangements of the members as well as the local properties of their unit cells. Thus, we utilize this scheme for structural optimization. Finally, we show an experimental validation of the theoretical model, by comparing the deployment patterns of a truss under multiaxial loadings, and the corresponding theoretical results.

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You are cordially invited to take part in the event!

Prof. Alexander Fidlin