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MetaLab Research Group
https://slesarenko-lab.com/

Cluster of Excellence *liv***Mat**S
FIT – Freiburg Center for Interactive Materials and Bioinspired Technologies,
IMTEK, University of Freiburg

Mechanical metamaterials to perform logical computations (HiWi, MSc)

Mechanical metamaterials are man-made materials engineered to achieve extreme mechanical properties, often beyond those found in most natural materials. The unconventional properties of mechanical metamaterials originate in their sophisticated internal architecture, usually fashioned from repeating unit cells. Therefore, if unit cells can change their geometry after fabrication, then metamaterial can obtain new properties more appropriate for the specific conditions. However, since unit cells are interconnected, the local changes in one location may lead to changes in other locations within metamaterial. Therefore the internal architecture can be rethought as a media that enables the interaction between unit cells.

This project aims to develop and study a class of mechanical metamaterials with **multistable** unit cells that can interact with each other. The embedment of the permanent magnets into the architecture of mechanical metamaterials will allow us to finely tune the local energy landscape by harnessing intricate interplay between elastic and magnetic energies. Since each of the unit cells can exist in a finite number of stable states, the interaction between multiple unit cells can be described as "digital". With this in mind, we will realize mechanical analogs of Boolean gates within the metamaterial architecture and will attempt to design simple computational circuits. Mechanical metamaterials will be fabricated with the help of a multimaterial 3D printer, allowing one to print with stiff and soft materials simultaneously.

The skills that you can acquire during this project:

1. CAD modeling
2. 3D printing (Polyjet**,** DLP, FDM)
3. Materials characterization
4. Basic mathematical modeling skills

Please feel free to contact us if you have any questions.

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