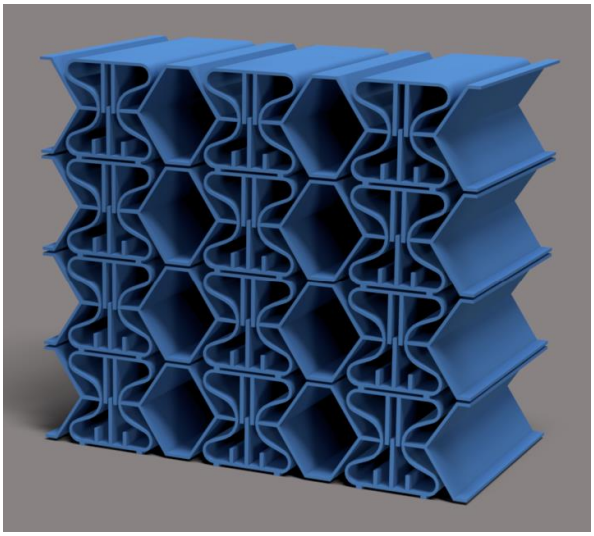
The department of Sustainable Systems Engineering - INATECH is now offering a Master's thesis at the Gips-Schüle Chair for Sustainable Systems Engineering (SSE) in Freiburg on the topic of

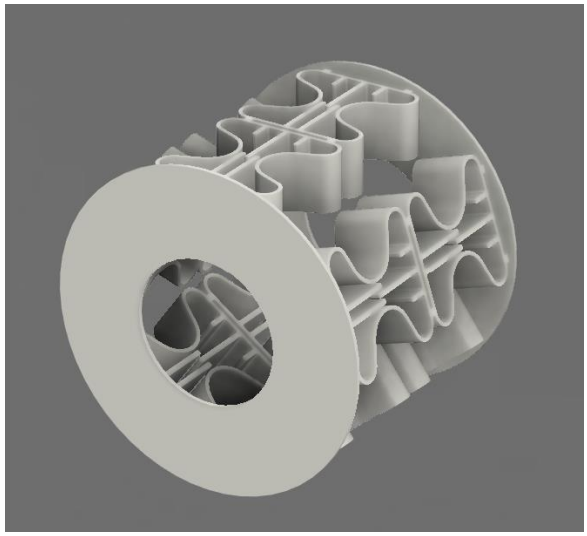
Design optimization and experimental characterization of 3D printed lattice structures for dynamic load requirements.

Background:

The Gips-Schüle Chair for Sustainable Systems Engineering (SSE) at INATECH deals with the design, optimization & experimental characterization of 3D printed lattice structures. Additively manufactured lattice structures provide excellent design freedom regarding cell structure, geometry, volume, strut size and material, thereby paving a way to control desired mechanical properties. This class of lightweight materials offer the potential to relatively engineer specific properties at the meso-scale to produce desirable macro-scale properties for various applications. In the case of crash loading scenario, large amounts of kinetic energy need to be dissipated on short time-scales to fulfill a certain safety criterion. To effectively achieve this task, strain-rate dependent materials, i.e., materials that behave differently at different speeds of deformation are essential. A unit cell with a friction mechanism is designed that shows a velocity dependent behaviour [1], that originally is weakly present in the base material. To witness such a behaviour from its lattice counterpart, the arrangement of the unit cells along with the geometrical optimization of the cells/structure play a vital role. Two preliminary arrangements are shown in the figure below. The deformation beahviour is largely dependent on the geometrical parameters of the arrangement. The aim is to achieve a strain rate dependent lattice structure, whose properties are largely governed by the geometry rather than the properties of the base material.

[1] S. Patil, G. Ganzenmüller, et.al., 2023, The Auxetic Friction Cell: Towards programming strain rate dependency and energy dissipation into mechanical metamaterials, Materials Today Communications





Tasks:

- Parametric design of lattice structure, considering the manufacturing constraints of additive manufacturing.
- Analysis & Modeling of the lattice structures: in particular nonlinear dynamic analysis with FEM and size optimization of the lattice.

- Experimental characterization under dynamic loads: from quasistatic to crash loads.

Prerequisites:

- Degree in mechanical engineering, sustainable systems engineering or a comparable engineering discipline (University/University of Applied Sciences).
- Interest in lightweight construction and in the development of innovative lightweight construction concepts.
- Previous knowledge on the application of numerical methods with solvers like LS-Dyna, Radioss etc.
- Knowledge of a programming language, preferably Python.

Supervision:

The work will be supervised by Sankalp Patil and Dr. Georg Ganzenmüller. You are expected to integrate into the work group at the Gips-Schüle chair for Sustainable Systems Engineering by Prof. Dr.-Ing. Stefan Hiermaier.

If you have any questions about this position, please contact:

M.Sc. Sankalp Patil
E-mail: sankalp.patil@inatech.uni-freiburg.de

We welcome applications on an ongoing basis. Please reach out with an email detailing your interest.