Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

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

Student project

Homogenization of mechanical properties of quasiperiodic architected materials

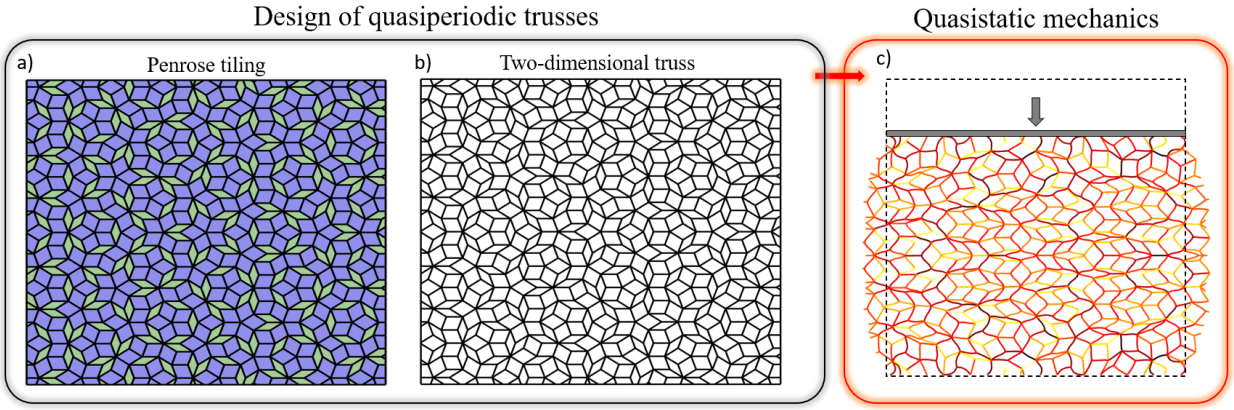

Figure 1: a) Example of a quasiperiodic tiling (Penrose tiling) (www.wikipedia.com). b) A truss-based architected material inspired by that same tiling. c) Illustration of quasi-static deformation behavior of quasiperiodic truss.

Description: Architected truss materials have enjoyed increasing popularity due to advances in 3d-printing, and they are currently being used in several applications. So far, the design space of such materials has been largely limited to periodic tessellations due to the ease with which their mechanical properties can be predicted. However, such periodic materials often either suffer from instabilities induced upon compression, or exhibit a lower-than-desired stiffness.

By contrast, quasiperiodic lattices, which lack translational symmetry but may possess rotational symmetry, promise a possible solution to the problem. Accordingly, this project involves the study of the effect of quasiperiodicity on the homogenized mechanical behavior of such lattices, both in the linear regime as well as in the presence of large deformations and self-contact.

The student is expected to approach the problem computationally while also supporting an ongoing experimental campaign. With the support of the supervisors, they will design different quasiperiodic lattices, develop efficient numerical models and investigate the computational homogenization problem of these lattices. The student will also assist with compression experiments carried out on 3D-printed architectures.

Prerequisites:

- Good background in mechanics
- Computer coding skills, experience with high level languages (C, C++)
- Basic knowledge of experimental mechanics

For more information, please contact:
Dr. Matheus Inguaggiato Nora Rosa, Dr. Konstantinos Karapiperis
Mechanics & Materials Lab
Dept. of Mechanical and Process Engineering
email: minguaggiato@ethz.ch kkarapiperis@ethz.ch