Master 2 internship proposal

Physique et Mécanique des Milieux Hétérogènes

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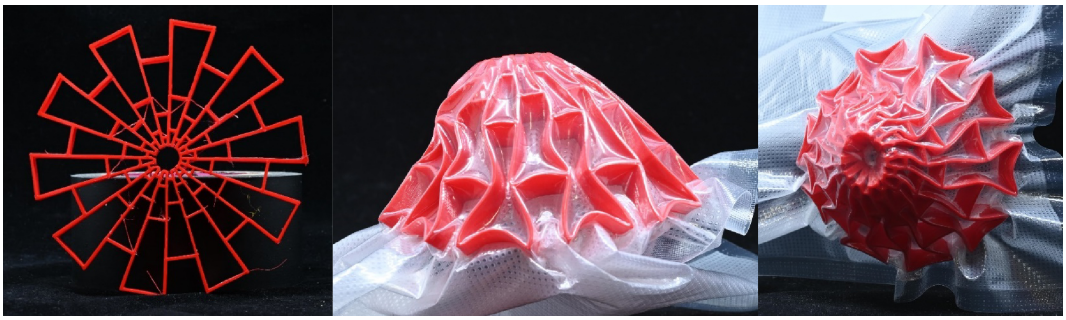
Internship location: Laboratoire PMMH

Physics and mechanics of deflatable reinforced structures

Two layers of inextensible fabric may be seamed together along lines to define a network of inflatable channels. When pressurized, the initially flat device deploys into a three dimensional shape controlled by the detailed design of the pneumatic network.
For some applications, such devices need reinforcement by an internal skeleton. We propose to explore the behavior of grid-like 3D printed structures trapped in an air-tight bag of fabric. As air is sucked out of the bag, the fabric penetrates the cells defined by the walls of the grid (see figure). The resulting forces tend to crush the cells, resulting in macroscopic dimensional variations and overall shape change. We propose to explore the physical parameters that rule these model deflatable reinforced systems. How should the material of the containing bag and of the skeleton be chosen to maximise the achievable deformations? How should one choose the geometry of the internal reinforcing structure to give rise to a target shape? What are the overall mechanical properties of the activated structures? Can one imagine large scale realisations? We will combine model experiments and minimal mathematical models to provide answers to these questions.



A 3D printed cellular structure is placed inside an airtight bag. When applying vaccum, the bag is sucked into the cells, deforms them, leading to out-of-plane deformations of the structure as a whole.

Expected skills: The project is mainly experimental, with minimal modeling of the observed phenomena.