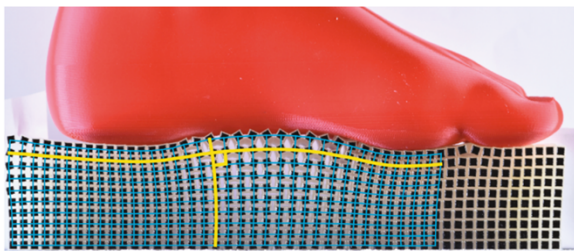


Design Viscoelasticity

Contact: martin.brandenbourger@univ-amu.fr

Context: Every interaction with our environment—from the shoes we wear to the helmets that protect us from impact—is shaped by how materials respond to applied forces. Although additive manufacturing has transformed the way we engineer mechanical properties, these advances often remain limited to static, academic models (Fig.1). Bridging the gap to real-world use requires designing materials with time-dependent behavior, capable of complex vibrations and high-velocity impacts of a dynamic world.

State of the art : Materials that adapt to load



Designed viscoelasticity : Flow-controlled dynamic load

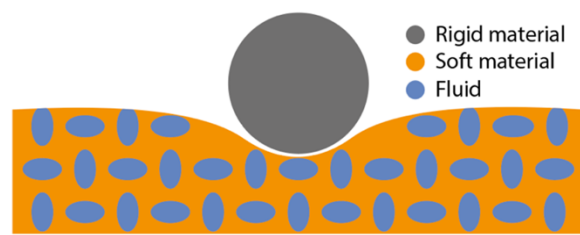


Figure 1 Abstract Figure State of the art research have designed the architecture of material to control their elasticity. We propose to combine architected material with fluids in hybrid materials with designed viscoelasticity.

The project: The internship will study a periodic elastomeric metamaterial [1] comprising 3D-printed, submillimetric channels filled with viscous liquid (Fig. 1). The student will characterize how the presence of fluid within the structure controls the relaxation time of the material (Fig. 1). The project will build on these results and characterize experimentally how the architecture of the tube (the distribution and size of the fluidic channels) and the viscosity of the fluid control the relaxation dynamics from few milliseconds to seconds. We will then study the mechanics of such a hybrid material under imposed deformation using tensile test machines and impact tests.

Duration: 5-6 months

Grant: 600 euros per month

Degree: M2, Starting from February 2027.

Location: IRPHE, 49 Rue F. Joliot Curie 13013 Marseille

Contact: Martin Brandenbourger (martin.brandenbourger@univ-amu.fr)

[1] Bertoldi, K., Vitelli, V., Christensen, J., & van Hecke, M. (2017). Flexible mechanical metamaterials. *Nature Reviews Materials*, 2, 17066.