Active mechanics of fluid transport

Active mechanics describes materials that consume energy to exert mechanical forces (Fig.1). It applies both to living matter and active materials, for which we have recently demonstrated exciting potential for applications [1,2]. So far, active materials are much less advanced than living matter. An ERC Starting Grant project (Self-Flow) has recently been started in the lab to bridge this gap between living and artificial matter. This project will create an artificial version of one of the simplest forms of life: the slime mold. The life of this organism is entirely based on a vascular network that actively contracts to transport fluids. Self-Flow aims at understanding how such self-contracting vascular network operates and, from there, create an artificial material that shows autonomous functionalities similar to living matter.

In this context, this internship will focus on explaining how active contractions generate fluid flows in an artificial channel. The student will work together with PhD students and postdocs and use experimental facilities to measure flows profiles in a channel that actively contracts. He/She will characterize these flow profiles as a function of the nature of the active contraction and the geometry of the channel by using imagery and image analysis techniques. He/She will develop models inspired by our previous studies on active solids to describe the propagation of active contractions and the flow rate that emerge from them. These results will open the way to a better modelling of living systems (from the slime mold to the lymphatic system) and the development of engineering applications via new functionalities in active artificial materials.

The internship can be followed by a PhD grant financed by the ERC Starting Grant Self-Flow.

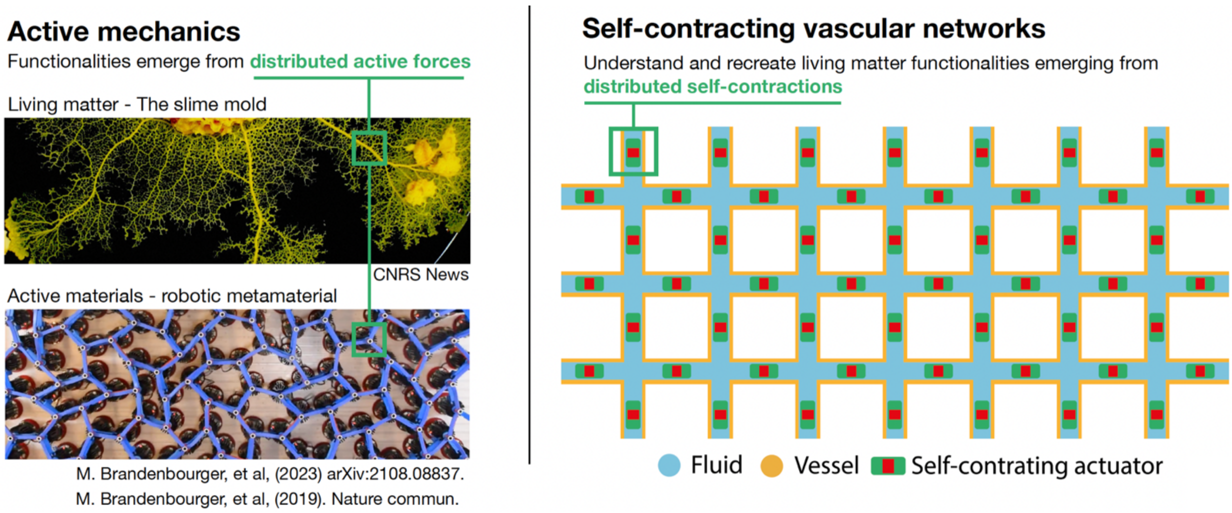

Figure 1 (Left) Two examples of systems described by active mechanics, a slime mold and a robotic material. (Right) Schematic of an artificial self-contracting network.

<u>Internship information:</u>
Duration: 5-6 months
Grant: 600 euros per month
Degree: from L3 to M2 Starting from February 2024.
Location: IRPHE, 49 Rue F. Joliot Curie 13013 Marseille
Contact: Martin Brandenbourger (martin.brandenbourger@univ-amu.fr)

References:
[1] Brandenbourger, M., Scheibner, C., Veenstra, J., Vitelli, V., & Coulais, C. (2021). Limit cycles turn active matter into robots. arXiv preprint arXiv:2108.08837.
[2] Brandenbourger, M., Locsin, X., Lerner, E., & Coulais, C. (2019). Non-reciprocal robotic metamaterials. Nature communications, 10(1), 4608.