European Research Council
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Internship

Active mechanics of fluid transport

Context. From unicellular organisms to human beings, liquid flows in vascular networks are among the most effective ways to transport matter and information for life. Artificial vascular networks have mimicked this strategy, without reproducing the same level of autonomy and adaptability. An ERC Starting Grant project (Self-Flow) has recently been started in the lab to bridge this gap between living and artificial matter [1,2]. 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.

In this context, this internship will explain 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 flow 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 emerges from them. These results will cast new light on active transport in vessel networks, including insights into human physiology and related diseases. By recreating active transport in artificial networks, he will also open the way to innovative solutions for adaptive cooling and water management technologies in networks that can easily be disassembled and reused. **The internship can be followed by a PhD grant financed by the ERC Starting Grant Self-Flow.**

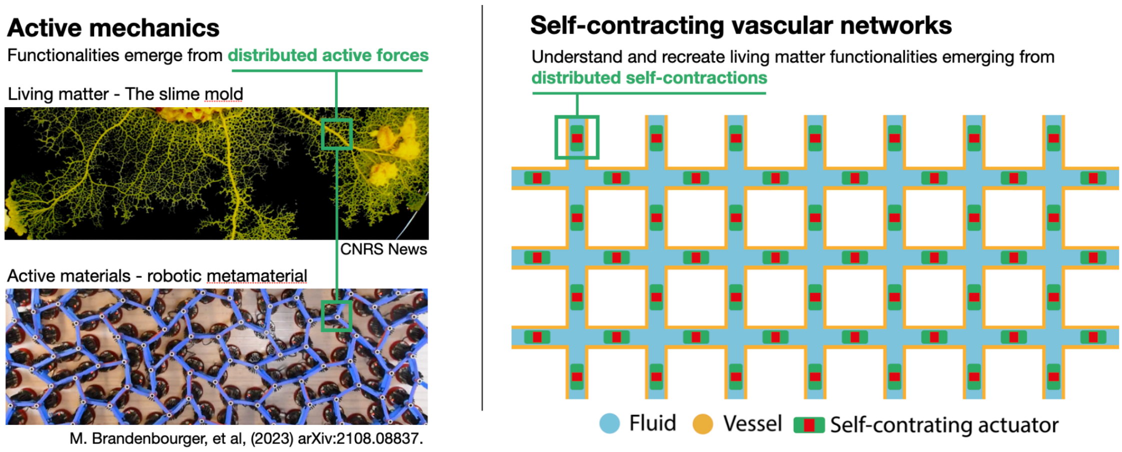

Figure 1 (Left) Two examples of systems described by active mechanics, a slime mold and a robotic material. (Right) Schematic of an artificial self-contracting network.

<u>Duration:</u> 5-6 months
<u>Grant:</u> 600 euros per month
<u>Degree:</u> M2, Starting from February 2026.
<u>Location:</u> IRPHE, 49 Rue F. Joliot Curie 13013 Marseille
<u>Contact:</u> 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 robo$c metamaterials. Nature communica$ons, 10(1), 4608.