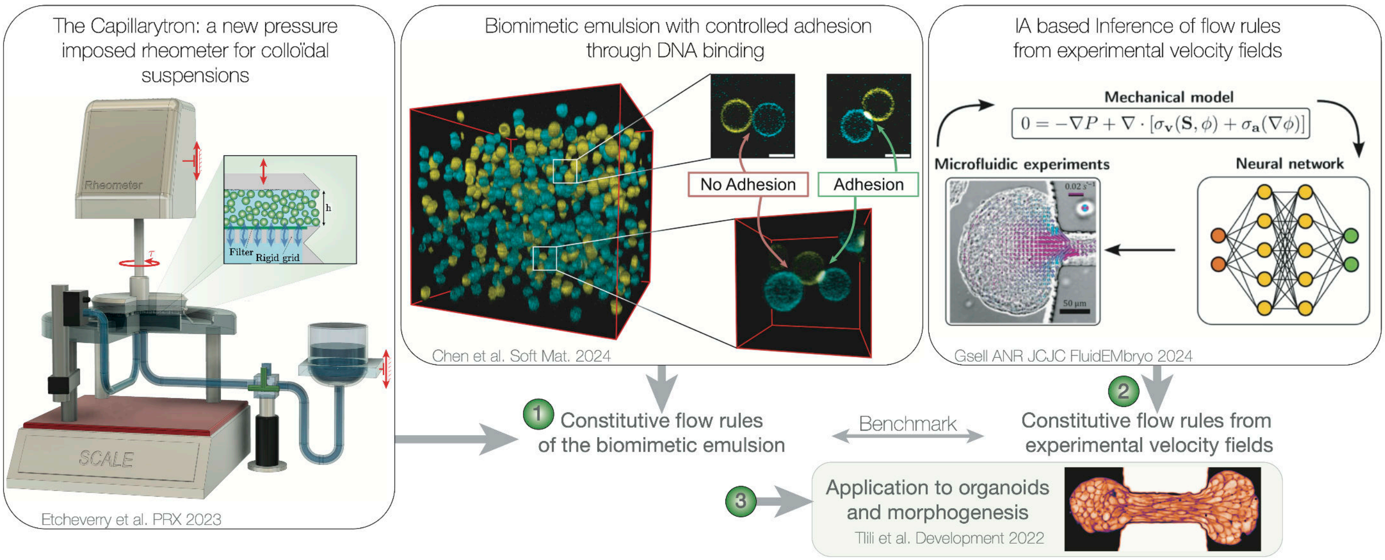
M1-M2 POSITION at IUSTI-IRPHE, Marseille, France

The Capillarytron for benchmarking AI-based inference of the mechanics of tissue morphogenesis

Mechanical and Engineering Institute of Marseille
Marseille, France
Target date: spring 2025
Web: https://bloenmetzger.wordpress.com/

Contacts:
Bloen.metzger@univ-amu.fr
Yoel.Forterre@univ-amu.fr
Simon.gsell@univ-amu.fr



Context & objectives

What role do mechanical forces play in morphogenesis? Can we describe a growing multi-cellular tissue, in which the coupling between mechanics, chemistry and biology is permanent, as a flowing `complex fluid'? What would be the `rheology' of such a medium? These questions are currently central to developmental biology and health applications, but also pose major challenges for physics and engineering. **The aim of this project is to tackle these questions using a biomimetic approach,** based on the skills in rheology and modeling of complex fluids and living environments present at IUSTI and IRPHE.

The candidate will undertake experimental advanced characterization of a biomimetic emulsion with adhesion force controlled through DNA binding [2], using a new pressure imposed rheometer, the Capillarytron [1]. Microfluidic flow measurements [3] will then be used to benchmark an IA based inference technique [4] with the aim of understanding the role of mechanical constraints on tissue reorganisation and cell differentiation. Candidates with either a Physics or Engineering backgrounds and interested in the general areas of soft matter, bio-mechanics, or fluid mechanics are welcome to apply.

Environment: IUSTI & IRPHE are CNRS laboratories of Aix Marseille University located in Marseille, France. This project will also benefit from strong national and international collaborations with IBDM and New York University. Applicants are welcome to contact Bloen Metzger with a detailed CV.

[1] Etcheverry B., Forterre Y., & Metzger B. (2023). Capillary-stress controlled rheometer reveals the dual rheology of shear-thickening suspensions. ***Physical Review X***, 13, 011024.
[2] Pontani, L. L., Jorjadze, I., Viasnoff, V., & Brujic, J. (2012). Biomimetic emulsions reveal the effect of mechanical forces on cell–cell adhesion. ***PNAS***, 109, 9839-9844.
[3] Tlili, S. L., Graner, F., & Delanoë-Ayari, H. (2022). A microfluidic platform to investigate the role of mechanical constraints on tissue reorganization. ***Development***, 149, dev200774.
[4] ANR JCJC FluidEmbryo 2024-2028, PI: Gsell S..