THE HIDDEN MECHANICS OF SOFT GELS

LABORATORY : Institut Lumière Matière
IN COOPERATION WITH : Institut Lumière Matière

LEVEL : M1 / M2 / L3
TEAM(S) : LIQ@INT

CONTACT(S) : BAIN Nicolas

CONTACT(S) DETAILS: nicolas.bain[at]univ-lyon1.fr /

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SCIENTIFIC CONTEXT :

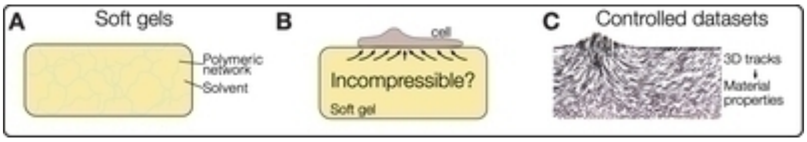

Fig. 1. Overview of the proposed project. Sorry it's blurry, I can email you a better version!

Gels constitute a large portion of the materials around us: body tissues, food products, but also industrial glues and seals. At first glance, they are mechanically similar to other elastic materials. If you take a piece of gelatin, for instance, you can deform it by a small amount and it will return to its original shape. If you look closer, however, gels have a complex molecular structure. They are made of a crosslinked polymeric network swollen by a liquid solvent (Fig. 1A). As a consequence, their mechanical behavior is dictated by the coupling between the elastic deformations of the polymeric network and the flow of the solvent. For simplicity, they are often modeled as incompressible solids, and these models are then used to estimate, for instance, adhesion forces of cells living on soft tissues [1](Fig. 1B). **Whether they truly behave as incompressible solids, however, is both difficult to asses and crucial for an accurate modeling.**

MISSIONS :

In this project, we will take a deep dive into gel mechanics. You will exploit recently collected experimental data, which tracks the 3D displacement of the polymeric network inside a silicone gel (Fig. 1C), to understand in which circumstances a gel can be modeled as an incompressible solid. This will involve numerically analyzing of the displacement of tens of thousands of tracers, and rationalizing the results within the framework of continuum mechanics. The results will be directly compared with existing numerical predictions [2].

OUTLOOKS :

Opportunity to continue as a Ph.D. student.

BIBLIOGRAPHY :

[1] H. Delanoë-Ayari and A. Nicolas. Quantifying active and resistive stresses in adherent cells. Phys. Rev. E (2 2022).

[2] M. M. Flapper et al. Reversal of Solvent Migration in Poroelastic Folds. Phys. Rev. Lett. (22 2023).

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