M2 internship and PhD thesis

On the pressure exerted by an active multicellular system

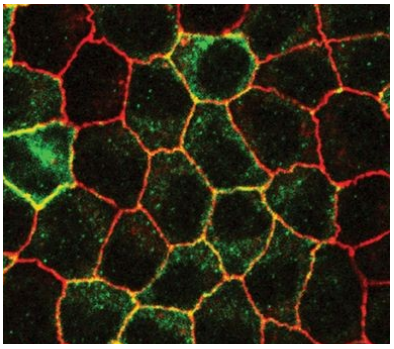
Laboratory :
Laboratoire Matière et Systèmes Complexes, UMR 7057 CNRS & Université Paris Cité,
10 rue A. Domon et L. Duquet, 75013 Paris.
Supervision : Marc Durand
E-mail : marc.durand@u-paris.fr
Web : https://www.marcdurand.net

Summary

Confluent biological tissues can be thought of as a*ctive multicellular systems:* they consume energy (ATP) to generate motion or change their conformation. This activity affects the pressure that a tissue exerts on a wall in a sophisticated way. Biological cells are much more complex than synthetic colloidal particles: they can deform, fluctuate, adapt, communicate, in ways that are inaccessible to synthetic units.

In this internship, we want to explore numerically how the activity affects the pressure exerted by an active cellular system on a wall. Different models of active cells will be proposed and compared. A one-dimensional theoretical approach can also be envisaged. This study will also address the question of how to measure non-perturbatively the pressure in a tissue. In recent years, deformable particles have been used as probes to measure stress within confluent biological tissues. However, it is known that the pressure is generally not a state function for active fluids, implying that the force exerted by an active fluid on a wall may depend on their specific interaction.

Required skills: the candidate should have a strong inclination for statistical physics and numerical simulations.



A cell monolayer (epithelium)