M2 RESEARCH INTERNSHIP PROPOSAL

Laboratory name: Physique et Mécanique des Milieux Hétérogènes (PMMH)
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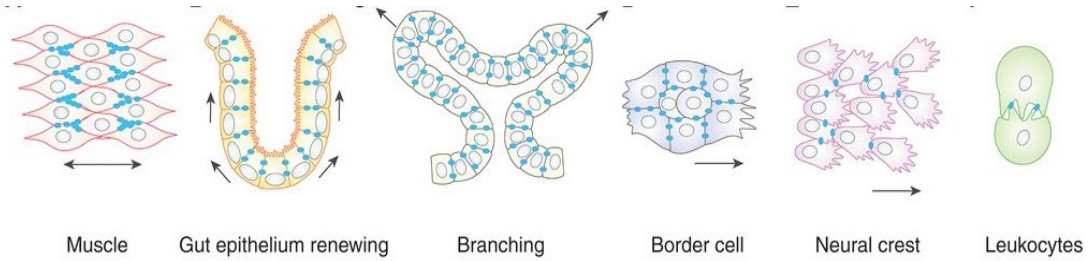
Internship location: PMMH laboratory, Jussieu campus

Thesis possibility after internship: YES

Collective cell migration

We recently proposed a theoretical framework [1] describing tissue flow at length scales large compared to the typical cell size, that naturally integrates cellular processes such as cell shape changes, cell rearrangements, cell division and cell death. Importantly, this hydrodynamic description involves biologically relevant parameters such as cell-cell junction tensions. Focusing on the interplay between cell shape changes and cell rearrangements, we elucidated mechanical behaviors underlying passive tissue relaxation, active contraction-elongation, and tissue shear flow [1].



Various modes of collective cell migration [3]

The goal of the present internship is to extend this framework to describe collective cell migration (see [2,3] for recent reviews) through the addition of the appropriate active terms. The student will investigate the spontaneous generation of tissue flow, and consider various applications such as cell jamming, as observed at high cell density, or cell proliferation patterning, as seen over time scales long compared to the typical cell cycle duration.
This internship will involve analytical and numerical calculations, at the interface between theoretical biophysics, the physics of active matter, and tissue mechanics.

References:

[1] S. Ishihara, P. Marcq and K.Sugimura, From cells to tissue: A continuum model of epithelial mechanics, Physical Review E **96** 022418 (2017)
[2] V. Hakim and P. Silberzan, Collective cell migration: a physics perspective, Reports on Progress in Physics **80** 076601 (2017)
[3] P. Friedl and R. Mayor, Tuning collective cell migration by cell–cell junction regulation, Cold Spring Harbor Perspectives in Biology, a029199 (2017)