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2-Year postdoctoral position
Turing Centre for Living Systems

Ref offer: PD2018-03

Computational study of cell pattern emergence in embryonic and tumorigenic tissues

Project abstract – The ability of cells to self-organize into patterned tissues composed of multiple cell types is central to animal morphogenesis and relies on both biological and physical factors. We propose to investigate numerically and from a biophysical point of view the pattern formation observed in two different complex tissues respectively characterised by their stereotyped vs seemingly disorganised structure: the embryonic epithelium of Xenopus (with A. Pasini) and Drosophila brain tumors (with C. Maurange).
In *Xenopus*, we will study how multiciliated cells (MCCs) distribute in a regularly spaced pattern during intercalation into an epithelial layer, and explore how the pattern is established and maintained through a balance between mutual repulsion among MCCs and attraction between MCCs and epithelial layer cells. In *Drosophila*, we will study how clusters of brain cancer stem cells (CSCs) form and how they affect tumor progression. We will investigate how physical (tension, adhesion) and biochemical (growth and differentiation factors) cues contribute to segregate clusters of cells with different self-renewing potentials, regulate their size distribution and density, and thus determine tumor growth rate.
The computational tools envisaged for the project involve the numerical implementation of energy minimization algorithms such as the Cellular Potts Model (with R. Clément). We plan to model both systems with an energy function encompassing the different biological and physical interactions suspected to play a role in the processes. Such energy functions can comprise adhesion, tension, affinities or repulsions among cell types. Motility and cell proliferation can also be implemented at given rates, depending on cell types. Models with be implemented in light of the experimental results, and we expect that simulations will in turn guide the design of new biological experiments.

Expected profile – Candidates should have a robust background in physics and numerical simulations, and ideally be familiar with the Potts Model and its cellular version. As the project is strongly interdisciplinary and involves close collaboration with experimental biologists, previous experience in developmental biology or biophysics will be appreciated. A strong interest in biological questions, in particular in the principles of morphogenesis, is mandatory.

Scientific environment – The recruited post-doc will benefit from a world-class interdisciplinary environment, both within the IBDM (Marseilles Institute for Developmental Biology) and among the other institutes taking part into the CENTURI program.

Supervisors

Raphaël Clément- IBDM, UMR 7288- Cell and tissue physics - Team Lenne
Cédric Maurange- IBDM, UMR7288- Neural stem cell plasticity - Team Maurange
Andrea Pasini- IBDM, UMR7288- Biology of ciliated epithelia - Team Kodjabachian

Deadline for application: 28th February

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