Internship
- Mathematical model of Adipose TIssue Dynamic -

Environment
Project: MATIDY - Mathematical model of Adipose TIssue DYnamic
MATIDY project is funded by ANR (JCJC CE45).

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Collaborators: Romain Yvinec (INRAE) and Hedi Soula (Sorbonne Université).

Location: The intern will be welcomed in the Laboratory of Computational and Quantitative Biology (LCQB), Sorbonne Université, Campus Jussieu, 7-9 Quai Saint Bernard, 75005 Paris, France.

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Project description
The general goal of MATIDY project is to develop mathematical models that describe the adipocyte size dynamics, based on exchange of lipids. We will study adipocyte size dynamics with mathematical models based on biological data (already available). In particular, we are interested in various health conditions (healthy, obesity, kidney diseases). One important feature will be to account for and describe the heterogeneity between cells.

Two different models have been developed in the project. First, at the cell level, the dynamics of one cell have been described by an ordinary differential equation (ODE). Second, at the cell population level, the dynamics of a density of cells have been described by a partial differential equation (PDE) structured by size (Soula et al., 2013).

One option to take into account the heterogeneity in the cell population using the ODE model is to allow parameters to vary from one cell to another. This lead to around 10000 ODE and all cell dynamics are coupled by the external lipid quantity. Another option is to add a diffusion term to the PDE and consider only one equation.

Internship work description
The internship will focus on
1. developing a numerical efficient scheme to simulate a large number of cell dynamics with the ODE system
2. generating realistic distributions with the ODE system
3. performing parameter estimation for the diffusion parameter of the PDE on the generated distribution
4. drawing conclusions on the link between the two models and the sources of heterogeneity

References
Soula H.A., Julienne H., Soulage C.O., and Geloen A. (2013) Modelling adipocytes size distribution. Journal of theoretical biology, 332, 89-95.

https://www.ljll.math.upmc.fr/audebertc/matidy.html