INTERNSHIP

STUDY OF CELL SHAPE CHANGES DURING EMBRYOGENESIS: APPLICATION TO THE SEA URCHIN

Developmental biology aims to better understand the morphogenesis. Image-based studies represent a method of choice therefore. From now on, microscopy techniques enable acquisition of temporal sequences of 3D images with a spatio-temporal resolution good enough to follow the embryo or organ development at sub-cellular scale [1]. While each still image allows to individualize each cell, the study of the temporal series may allow to extract the cell lineage and thus to follow one cell during the development and to recognize the cell division.

The acquisition of 3D+t series results in huge quantities of data. Obviously, manual analysis of such amount of images is not possible and sophisticated image analysis tools have been developed in the recent years for this particular goal [2]. A first study [3] has already permits to segment the cells and to track them along time, each acquisition being made of more than a hundred of 3D images. This approach has been successfully adapted to temporal series of sea urchin embryo images [4] in a joint research between the Morpheme team and Rauzi's team. Such results give access to a detailed morphometric analysis of single cell shapes.

We are interested in the gastrulation phase of the sea urchin embryo. During this phase, a cavity appears which implies mechanical constraints at the cellular level. Such constraints also cause specific cell shape evolution. The goal of this thesis is then to characterize the 3D cell shape evolution at an individual level and to recognize cell population exhibiting similar evolution.

Requirements:

1. Last year of master in computer sciences or applied mathematics
2. Knowledge in image processing, preferably 3D
3. Computer skills: programming (python), image processing/graphics libraries
4. Written and spoken English

Practical information:

1. This work takes place in a collaboration between IBV (M. Rauzi's team) and Morpheme, a joint research team between INRIA, CNRS and the University of Nice Côte d'Azur.
2. This internship is located in Sophia Antipolis (French Riviera).
3. This internship is remunerated.
4. To candidate, please send a curriculum vitae, referees coordinates and a motivation letter to
    - Grégoire Malandain (Gregoire.Malandain@inria.fr)

Bibliography

[1] PJ Keller, "Imaging Morphogenesis: Technological Advances and Biological Insights," Science, vol. 340, no. 6137, pp. 1234168+, June 2013.

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[2] R Fernandez, P Das, V Mirabet, E Moscardi, J Traas, JL Verdeil, G Malandain, and C Godin, “Imaging plant growth in 4-d: robust tissue reconstruction and lineaging at cell resolution,”Nat Meth, vol. 7, pp. 547–553, 2010.
[3] Guignard, L., Fiuza, U.-M., Leggio, B., Laussu, J., Faure, E., Michelin, G., Biasuz, K., Hufnagel, L., Malandain, G., Godin, C., and Lemaire, P. (2020). Contact-area dependent cell communications and the morphological invariance of ascidian embryogenesis. Science, accepted for publication.
[4] Moullet, A. (2020) “Automated segmentation of sea urchin embryos”, Ms thesis.