# INTERNSHIP

## SEGMENTATION AND TRACKING OF CELLS IN 3D+T SERIES

The goal of this internship is to propose new schemes of segmentation and tracking of cells in 3D+t series of microscopy images.

The embryo development may be highly reproducible (ie stereotyped) within one given species: in some of them, cells can be even unambiguously named through the whole development (e.g. C. elegans) or during the first stages of the embryogenesis (e.g. ascidians [Lemaire 2011]). Such models are then highly attractive for developmental studies. On the other hand, current live microscopy techniques allow the acquisition of temporal sequences of 3D images with a spatio-temporal resolution high enough to follow embryo development at sub-cellular scale [Keller, 2013]. Among them, the light sheet microscopy [Krzic, 2012] allows to image developing embryos of ascidians from the very early stages to the gastrulation stage. It offers an unique opportunity to not only study the development of individuals but also to study the development variability within a population.

A first study [Guignard, 2020] has already permits to extract cell characteristics and lineages for a dozen of embryos (of wild type ascidians), each acquisition being made of more than a hundred of 3D images. In addition, cells can be named in the first developmental stages, based on [Conklin, 1905].

Although yielding good results, the segmentation/tracking approach of [Guignard, 2020] still requires a large computational time, and unavoidable errors have to be manually detected and corrected.

The goal of this internship is to investigate whether this segmentation/tracking approach can be improved, both in term of computational efficiency and of segmentation/tracking quality. This will be addressed either by introducing new segmentation schemes, or by taking advantage of a first database of already segmented 3D+t series.

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 CRBM (P. Lemaire'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

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