

Ph.D. topic 2015

## Learning and tracking in 3D+t biomedical data

Supervisor

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### Presentation of the Ph.D. topic

In modern biology, imaging is a key element of all research, especially in developmental biology. Imaging a developing embryo from 1 cell to advanced stage with up to thousands of cells is becoming more and more common, and helps understand the basics of cell behavior and differentiation. Many algorithms are available for cell tracking, but most of them rely on a prior accurate detection of the cells. However when the number of cells is high, accurate detection of cells may be difficult. Novel techniques such as machine learning can provide reliable maps for segmentation, in a noisy and evolving context. Combining machine learning with tracking should help improve detection and segmentations of nuclei.

### Expected deliverables

The candidate will first improve developed learning techniques, for robustness and speed. Furthermore as the temporal aspect is important, the machine learning technique should take this aspect into account. The candidate will also implement different tracking algorithms, based on biological rules (move and division). The tracking results should then be analyzed, and in case of aberrant associations between two time frames, the algorithm should give a feedback on how much and where possible erroneous or missing detections occurred. The final segmentation algorithm will take the results of tracking and machine learning to propose a error-free segmentation. Furthermore we recently implemented a segmentation/classification procedure based on cell nucleus shape to classify the stage of cell division (GulMohammed, BMC Bioinformatics 2014). The tracking algorithm should also use this information of nucleus shape and stage to improve both tracking and segmentation.

Many applications are planned in different areas with different Singaporeans collaborators in I2R, NUS and BII.

### Keywords

Image analysis, segmentation, 3D, 4D, tracking, machine learning.

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### Applicant profile

- Master Degree or Engineer Student (last year of studies).
- Skills in programming, preferably JAVA, and Matlab.
- Notions in image processing and machine learning.
- Open to work with both French and Singaporean scientists.
- Availability for starting October 2015.

**Gratification:** Compliant to French Regulation on Ph.D. students (Contrat doctoral)

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