



I³: Interactive and Intelligent Interface for stem cell tracking

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

The project will focus on the development of a user-friendly interface for biologists, which will assist biologist in performing cell tracking from time-lapse microscopy data of mouse blood stem cells and/or mouse embryonic stem cells.

Background and Motivation

Within a project in collaboration with the Helmholtz Zentrum, we are working on the development of tools that can assist biologists in quantifying certain processes occurring during the differentiation of stem cells. For this, biologists acquire with special microscope images of a culture of stem cells over time (time-lapse). For quantification purposes the cells have to be detected and then followed from frame to frame. This is in many cases still done manually by biologists. Because this is a tedious procedure, there has been an increasing interest in developing automatic tools for cell tracking. However, biologists cannot fully trust these tools, as they are never 100% reliable. We consider that an intermediate solution to this problem is to develop tools that assist the biologist to label the data instead of fully replacing his expertise with a fully automatized approach. In order to achieve this, we will rely and extend an existing method for cell detection (based on a machine learning technique called Random Forests). The extension will include a method to detect the frames where there is need from the biologist input to resolve a problem with the detection or tracking.

Student's Tasks Description

The student tasks include the development of a program which i) selects frames with ambiguous cell detections or tracking problems, ii) shows these frames to the biologist, iii) allows the biologist to interactively correct the cell detection or tracking error and iv) visualizes a graph of the cells tracked over time.

The student will gather experience on C++ programming and in the development of interactive interfaces using Qt. Furthermore he will learn to interact with specialists from a different discipline.

Technical Prerequisites

Basic knowledge in C/C++ will be desirable.

Administrative Info

Project Location: CAMP/TUM + some punctual visits to Helmholtz Zentrum

Required Equipment: None, datasets will be provided by the Helmholtz partners.

Timeline and Milestones

At 4 weeks: visualization of the current cell detection results

At 8 weeks: Tools for interactive labeling

At 12 weeks: selection of intelligent frames and update of tracking graph

References

<http://www.youtube.com/watch?v=SLYgvHzAm2>

Li et al, Cell population tracking and lineage construction with spatiotemporal context, Medical Image Analysis, 2008

Liu et al, A semi-Markov model for mitosis segmentation in time-lapse phase contrast microscopy image sequences of stem cell populations, Transactions on Medical Imaging, 2012