



Project Management and Software Development for Medical Applications

General Info

Project Title: Droplets tracking within microfluidic systems

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Project Abstract

Dissecting a cell population is a promising approach for many biological applications such as genotyping-phenotyping studies or for population segmentation for drugs.

A novel miniaturized droplet-based tool is in development for this purpose. The goal of this project is to detect and track droplets to estimate their velocity and compare the signals from frame to frame.

Background and Motivation

Droplet-based microfluidic systems are used in many life science applications such as PCR or directed evolution. The volumes of the droplets are usually in the order of nl to pl in size and can reach production rates in the kHz range, thus ideal for many cell-based applications where high throughput is required. Functional tests are usually carried out with fluorescent markers, which bind onto the cell surface or a binding site within the cell. The fluorescent marker is excited and the emission is recorded with a photomultiplier tube.

However existing droplet microfluidic systems or commercially available flow cytometers only allow measuring single time-points of fluorescent signals.

A novel system is in development, which uses a camera to capture an entire field of view on a microscope at low magnification to capture multiple times the signal of a droplet enabling thus kinetic studies of individual cells. With this

approach, heterogeneity of any cell population can be therefore studied in more detail than with existing systems.

One of the challenges of this approach lies in tracking the droplets from one frame to the next, a process that has to be currently carried out manually. An automated routine would greatly facilitate the analysis of the results obtained with this system.

Student's Tasks Description

The student is expected to write a routine performing automatic or semi-automatic detection and tracking of the droplets over time. Ideally, this routine should be able to run real-time. The detection algorithm can be based on pre-built machine learning routines that are available within the chair.

This project can offer a good introduction to machine learning and multi-target tracking methods, although the student remains free to choose alternative relevant approaches.

Technical Prerequisites

Good knowledge of Matlab or C/C++.
A first experience in computer vision / image analysis would be beneficial.

Administrative Info

Working Time: Approx. 100 hours

Project Location: Garching

Required Equipment: Laptop

Timeline and Milestones

3 milestones corresponding to the 3 lectures

References

Teh et al, Lab Chip, 2008
Schaerli et al, Molecular Biosystems, 2009
Criminisi et al, Microsoft Research technical report on random forests, 2011

Please send the completed document to us (Ralf.stauder@tum.de) before the project proposal deadline, September 30th. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in the case of acceptance.