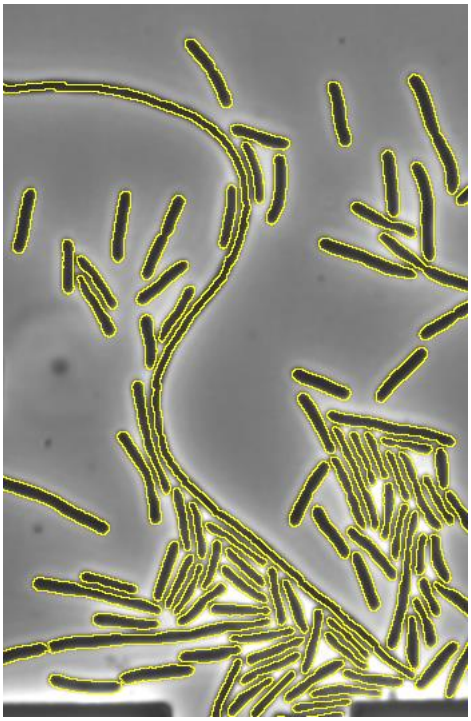
HDSLEE | HELMHOLTZ SCHOOL FOR DATA SCIENCE IN LIFE | EARTH | ENERGY

PhD project “Geometry-aware image analysis for microfluidic live-cell experimentation”

The Helmholtz School for Data Science in Life, Earth and Energy (HDS-LEE) provides an interdisciplinary environment for educating the next generation of data scientists in close contact to domain-specific knowledge and research. All three domains – life & medical sciences, earth sciences, and energy systems/materials – are characterized by the generation of huge heterogeneously structured data sets, which have to be evaluated in order to obtain a holistic understanding of very complex systems.

Project overview

Microfluidic single-cell analysis with time-lapse microscopy is an emerging technology, which offers new opportunities to approach fundamental and applied biological questions. Specifically, the precise control over environmental parameters (medium, temperature, light) in combination with biosensors/optogenetic tools generate informative systems responses that are recorded in form of high volume time-lapse image sequences. In these images, pre-processing, segmentation and tracking tasks are faced with varying noise levels, low intensity gradients and limited temporal resolution. Robust, high-fidelity segmentation of the phase contrast time-lapse image data benefits both, image-based experimentation control (e.g. instantaneous or via data assimilation) and model-based inference (e.g. construction or refinement of single-cell models describing cellular behavior).



The PhD project aims at improving the current status of bacterial image analysis:

(1) Increasing the accuracy and robustness of single-cell segmentation algorithms by taking cell shape geometry into account;
(2) Iterative cell-segmentation-and-tracking rather than following a purely sequential approach;
(3) Unlock joint uncertainty-aware segmentation and tracking.

Your Job:

In a first step, geometric prior information will be integrated into a variational segmentation formulation and applied to rod-shaped bacteria. Segmentations across several frames will be linked by lineage tree estimates, available through training data. An iterative approach will be investigated towards self-correcting joint segmentation and tracking. Furthermore, we will link the variational description of cell shape geometry with a particle-filter based tracking approach to enable uncertainty-estimation of single-cell measures through joint segmentation/tracking and improve computational performance.

Your profile

- Master's or equivalent degree in mathematics, computational science or a related field with a superior academic record
- Highly motivated candidate with strong mathematical skills
- Knowledge in signal/image processing, optimization and/or data analysis is desired
- Good programming skills are of advantage (preferably Python or C++)
- Excellent communication skills in English are mandatory: TOEFL or equivalent evidence of English-speaking skills
- You are convincing with your confident attitude and good communication skills

- Outstanding organizational skills and the ability to work independently
- Very good cooperation and communication skills and ability to work as part of a team in an international and interdisciplinary environment

Our offer

Applicants are invited for a PhD student position in the Mathematical Image and Signal Processing group (Prof. Dr. Benjamin Berkels; https://www.aices.rwth-aachen.de/en/people/berkels) at RWTH Aachen, Germany within the Helmholtz School for Data Science in Life, Earth School and Energy (HDS-LEE).

- Unique HDS-LEE graduate school program
- A position in a creative and international team that conducts research at the frontiers of science.
- Outstanding scientific and technical infrastructure – ideal conditions for successfully completing a doctoral degree
- Chance of participating in (international) conferences
- Continuous scientific mentoring by your scientific advisor
- Doctoral degree conferred by RWTH Aachen University
- Further development of your personal strengths, e.g. via a comprehensive further training program
- 3 year position
- Pay in line with 100 % of pay group 13 of the Collective Agreement for the Public Service (TV-L)

Applicants should submit applications (a one-page letter of motivation why they are interested in the respective project and how they can contribute to the project's success, a current CV, and contact data of three references) by email to berkels@aices.rwth-aachen.de. Please provide all documents as one PDF file.

Apply until: 31th May 2019

Starting date: 1st July 2019