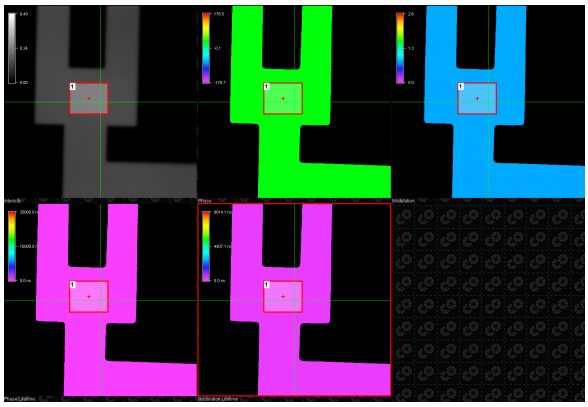
HDSLEE | HELMHOLTZ SCHOOL FOR DATA SCIENCE IN LIFE | EARTH | ENERGY

PhD project "Quantitative biosensor analysis for microfluidic live-cell experiments using frequency domain fluorescent lifetime imaging microscopy"

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

Live-cell imaging with ultra-parallel microfluidic lab-on-chip systems is gaining traction in bioprocess development as a cost-efficient frontline tool. Optogenetic sensing by genomically integrated Fluorescence Resonance Energy Transfer (FRET)-based biosensors are capable to visualize spatio-temporal extracellular and intracellular target molecule concentrations on single-cell level. Since the duration of fluorophore emissions is sensitive to microenvironmental conditions, Fluorescent Lifetime Imaging Microscopy (FLIM) allows for online monitoring of sensor metabolite concentrations. Extraction of information captured with frequency-domain (FD) FLIM are computationally complex and existing solutions scarce and practically limited (e.g. region of interest-based analysis is virtually impossible), making feature extraction extremely laborious and time-consuming. This hampers the in-depth characterization of the biosensors.



FD-FLIM calibration measurement example

The PhD project aims at making quantitative FLIM image analysis of microbes labeled with FRET-based biosensors accessible.

Your Job:

(A) Formulate FD-FLIM as inverse problem considering tailored noise models and spatio-temporal lifetime features;
(B) Numerical solution of the non-convex inverse problem by lifting the optimization problem to a higher dimensional space;
(C) Construction of convolutional neuronal nets (CNNs), trained with numerical high-quality solutions, for fast FD-FLIM reconstruction.

The approach will be tested with FD-FLIM data sets featuring FRET-based biosensors, generated at IBG-1, FZJ.

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

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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: 31st May 2022

Starting date: 1st July 2022