

Change Point Detection in Microbial Growth under Oscillating Environmental Conditions

About Us: The “Microsystems in Bioprocess Engineering” group is situated within the Chemical Engineering (CIW) Faculty of the KIT. Our goal is to bridge the gap between microfluidic technologies and bioprocess development. We develop novel microfluidic tools (e.g., single-cell cultivation systems) and apply them to investigate research questions relevant to bioprocessing. Utilizing the acquired knowledge, our aim is to pioneer the development and establishment of new bioprocesses. Our work is conducted in a highly interdisciplinary manner, involving collaboration with experts in e.g. microbiology, physics, material and data science.

Background: Modern high-throughput live single-cell microscopy relies heavily on automated data analysis pipelines in order to extract meaningful biological insights from the vast amount of generated data. When investigating microbial growth under oscillating environmental conditions, such as changes in glucose concentration or pH, detection of change points in growth dynamics is crucial to understand the susceptibility of the organisms under consideration to said environmental oscillation. Not only may the growth rate change but the very characteristic of growth may switch from the well-known exponential regime to - for example - linear growth. Bayesian model selection algorithms hold great promises to identify such change points in a statistically sound manner while providing uncertainty estimates, making results more reliable.

Project Aim: This project aims to develop, implement and test Bayesian model selection algorithms to automatically identify changes in growth dynamics during experiments with oscillating environmental conditions. The algorithms will be implemented in Python and initially be tested on existing data, while later moving to real on-going experiments.

Your Tasks:

- Familiarize yourself with the key concepts in Bayesian statistics and model selection
- Implement Bayesian model selection algorithms in Python
- Test the implementations on existing and synthetic data
- Deploy your method to on-going experiments in the lab

Your Qualifications:

- Background in bioengineering, biotechnology, mathematics, computer science or physics
- Good programming skills in Python
- Solid mathematical background
- Interest in multidisciplinary research
- Good written and spoken English skills
- Structured, independent and meticulous working method

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