

Machine Learning-Assisted Signal Analysis for Analytical Instrumentation

Summary

In the evolving landscape of analytical methods, there is a growing demand for advanced analysis techniques that provide enhanced detection and quantification capabilities (such as environmental monitoring, food safety, and healthcare). To address this need, we are seeking to develop innovative portable analytical instruments based on capillary electrophoresis (CE) with various detectors, such as fluorescence and conductivity detectors. Your objective is to leverage the power of machine learning methods for signal analysis in combination with Fourier transform to improve the accuracy and reliability of analysis results.

Research field:	Information and communication technology
Supervisors:	Prof. Dr. Jekaterina Mazina-Šinkar Dr. Evelin Halling
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Software Science
Application deadline:	Applications are accepted between June 01, 2023 00:00 and June 30, 2023 23:59 (Europe/Zurich)

Description

The primary objective of this research is to enhance the accuracy and reliability of analysis results by leveraging the power of machine learning methods for signal analysis in combination with Fourier transform. By combining the high separation efficiency of CE with multi-dimensional detection techniques, a variety of signals are generated. The goal is to extract valuable insights from the CE data and establish distinct fingerprints for a wide range of analytes. To achieve this, you will research various machine learning algorithms for signal analysis. The aim is to enhance the signal-to-noise ratios, improve detection accuracy, and enable robust quantification.

Some of the possible research questions are as follows:

- How can we optimize the use of Fourier transform for extracting features from CE electropherogram data?
- Which machine learning algorithms are most effective for analyzing CE electropherogram data, and how can we optimize their performance?
- How can we evaluate the generalizability of machine learning models for CE data analysis across different datasets and laboratories?
- How can we integrate Fourier transform and machine learning with other data analysis techniques to further improve the accuracy and efficiency of CE data analysis?
- How can we apply the developed methods to real-world applications, such as the analysis of complex biological samples?

As a candidate with an IT background, you will have the opportunity to work in a collaborative and multidisciplinary research environment.

Supervisor: Dr. Evelin Halling (Department of Software Science)

Co-supervisor: Assistant Prof. Dr. Jekaterina Mazina-Šinkar (Department of Chemistry and Biotechnology)

Responsibilities and (foreseen) tasks:

- Conduct research on the development and optimization of Fourier transform and machine learning methods for analyzing CE electropherogram data
- Analyze experimental CE data and evaluate the performance of different data analysis methods
- Collaborate with other researchers and industry partners to develop new applications for CE data analysis
- Write scientific publications and present research findings at conferences and meetings

- Participate in departmental activities, such as seminars and workshops
- Supervise students

Applicants should fulfil the following requirements:

- a master's degree in information technologies, computer science or related fields
- the candidate has a high academic level
- a clear interest in the topic of the position
- programming skills
- excellent command of English
- strong and demonstrable writing and analytical skills
- capacity to work both as an independent researcher and as part of an international team
- capacity and willingness to provide assistance in organizational tasks relevant to the project

The following experience is beneficial:

- Working knowledge of machine learning
- Working knowledge of Python
- Working knowledge of statistics

We offer:

- A fully paid 4-year PhD position
- The chance to do high-level research in a multidisciplinary team (chemists, IT, engineers)
- Opportunities for conference visits, research stays, and networking

About the department

The mission of the Department of Software Science at Tallinn University of Technology is to advance internationally and nationally relevant state of the art in research and apply it in bachelor, MSc and doctoral education in the areas of computer science, information systems, data science, artificial intelligence and cyber security with the goal to solve problems the society is facing and support sustainable development. The research groups and laboratories are autonomous, strong and successful participants in attracting research funding and are able and willing to participate in research and innovation heavy collaboration with enterprises and the public sector, both in Estonia and abroad.

Additional information

For further information, please contact Dr. Evelin Halling (evelin.halling@taltech.ee).



To get more information or to apply online, visit <https://taltech.glowbase.com/positions/671> or scan the the code on the left with your smartphone.