

Development of Validation, Analysis, and Mapping models for data collection in Extreme Environments

Summary

The main focus of this PhD project is to develop state-of-the-art data analysis and mapping methods that are efficient, reliable, and near real-time. The developed methods will play a key role in advancing methodologies for collecting, validating, and analyzing environmental data from challenging and hard-to-access environments (e.g., subglacial channels, underwater ecosystems, and abandoned mines). This project will concentrate on environmental data collected using various sensors and robot platforms designed and developed at the Center for Biorobotics at Tallinn University of Technology.

Research field:	Information and communication technology
Supervisors:	Prof. Dr. Maarja Kruusmaa Dr. Laura Piho
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Computer Systems
Application deadline:	Applications are accepted between June 01, 2024 00:00 and June 30, 2024 23:59 (Europe/Zurich)

Description

Supervisors

Main supervisor: Dr. Laura Piho

Co-supervisor: Prof. Dr. Maarja Kruusmaa

Project Overview: We invite applicants for a fully funded Early Stage Researcher PhD position to contribute to cutting-edge research in data validation, analysis, and mapping for data collected in extreme environments. The main aim of this project is to develop state-of-the-art data analysis and mapping methods that are efficient, reliable, and near real-time. The successful candidate will play a key role in advancing methodologies for collecting, validating, and analyzing environmental data from challenging and hard-to-access environments (e.g., subglacial channels, underwater ecosystems, and abandoned mines). This project will concentrate on environmental data collected using various sensors and robot platforms designed and developed at the Center for Biorobotics at Tallinn University of Technology.

Research Focus: Collecting, processing and analysing environmental data from extreme environments is crucial for various scientific and industrial disciplines, such as coastal monitoring, seabed analysis and mapping, monitoring rivers for extreme water, levels and managing water supplies, predicting extreme weather events, evaluating flooding and rising sea level, estimating the speed of which glaciers, ice caps and snow fields disappear. However, the conventional approach of validating and analyzing this data post-experimentally poses significant challenges, including time delays and potential data loss. The goal of this project is to address these challenges by designing and implementing real-time data validation and analysis methods and algorithms, allowing for better insights and decision-making during data collection campaigns. This project gives a great opportunity to dive into the world of mathematical models, machine learning, multimodal sensing, and data-fusion, with the goal to increase good quality data collection through adaptive sampling, validated critical environmental datasets, and increase accuracy of the collected data.

Key Objectives:

- Develop robust data validation methods that can be implemented on-the-field in extreme environments
- Design efficient and accurate data analysis techniques and algorithms tailored for real-time application
- Accelerate the data analysis process to enable quicker knowledge extraction and sharing

Qualifications: Prospective candidates should:

- Hold a Master's degree in a relevant field, such as Data Science, Mathematics, Computer Science, Environmental Science, Mechanical Engineering, Control, or a related discipline



- Have a keen interest in the topic and capacity to work both independently and as part of an international team
- A capacity and willingness to aid in organizational tasks relevant to the project
- Good writing and analytical skills. Good written and spoken English. (B2 or equivalent)

(Following qualification will be beneficial)

- Scientific computing
- Strong programming skills (Python, C++ , etc.). Familiarity with pandas, scipy, tensorflow.
- Experience with embedded systems and microcontrollers
- Experience in developing real-time data processing algorithms
- Working with environmental data will be considered advantageous.

PhD supervisor contact: laura.piho@taltech.ee , maarja.kruusmaa@taltech.ee.

We offer:

- 4-year PhD position in a bioinspired robotics groups in Estonia with 10+ years' experience in international and national funded projects
- Chance to do high-quality research in one of the most challenging fields of environmental monitoring
- Opportunities for conference visits, research stays and networking with various cooperation partners
- The university employs the Early Stage Researcher with a salary meeting or exceeding the average wage in Estonia (1828€ gross).

About the Centre for Biorobotics

The Centre for Biorobotics specializes in research and development of underwater robotics and sensing. We are focusing on using bioinspired sensing methods in combination with conventional tools to improve situational awareness and navigation performance of our robots. Apart from robotics, we are also applying bioinspired sensing methods in water flow sensing in natural environments (rivers, coast etc.) and develop methods to investigate extreme flows including sub-glacial flows, rivers etc.

Our core competences are as follows:

- Mapping and navigation of unstructured environments
- Development and manufacturing of underwater robotic platforms
- Robot locomotion and control in multiphase environments
- Underwater sensing with applications in natural environments

Some of our research activities include:

- Distributed sensor networks for measuring and characterizing flow and turbulence
- Development of underwater sensor systems for safe navigation in harbors
- Measuring extreme flows including sub-glacial flows, rivers etc.
- Environmental sensors for monitoring and protection of critical infrastructure
- Developing new principles of locomotion using soft and compliant actuators
- Control and navigation of underwater robots in flow, surges, and waves
- Robot sensing in underwater environments



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