

Modelling and control of robot locomotion in mixed terrains

Summary

This PhD project will investigate modelling and control methods for robot locomotion in mixed dry and submerged environments, in or over yielding terrains. Candidates from robotics-related disciplines with a strong control systems background are invited to apply. The work will be part of the upcoming EU-funded project PIPEON, which will investigate robotics and AI for inspection and maintenance of sewer pipes.

Research field:	Information and communication technology
Supervisor:	Prof. Dr. Maarja Kruusmaa
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Computer Systems
Application deadline:	Applications are accepted between June 01, 2025 00:00 and June 30, 2025 23:59 (Europe/Zurich)

Description

The research

Accurate and stable locomotion is challenging but crucial for mobile robots in dynamic unstructured environments (such as sewers), that contain a combination of solid ground, loose or thick sediment layers. Additionally, locomotion systems that use reconfigurable actuators with non-traditional morphology, optimized for locomotion in these environments, may increase the complexity of the robot's control.

In this context, this PhD project will investigate modelling and control methods for robot locomotion in these challenging terrains, aiming to develop a robust control algorithms for locomotion. In particular, the focus is on modelling and control between the dynamic environment and the robot's locomotion system, and on evaluating the controller performance not only in simulation but also in the physical sewer pipe environment.

The modelling effort will take into account the locomotion system's states and control inputs, as well as the condition of the terrain, to estimate the behaviour of the robot as it interacts with the dynamic environment.

The candidate will work in the EU-funded project PIPEON with 14 partners (academic, industrial and public) and will contribute towards integration, testing and validation of the methods and prototypes of the project.

Responsibilities

- Investigate and model the interaction between the robot and the terrain in the context of locomotion in mixed terrains
- Design, implement, and evaluate control strategies for robot locomotion
- Publish achieved results in high-quality journals and top conferences in robotics

Applicants should fulfill the following requirements:

- A master's degree in robotics-related engineering discipline with a strong background in control systems
- A clear interest in the topic of the position
- Excellent command of the English language
- 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 aid in organizational tasks relevant to the project

The following experience is beneficial:



- Experimental and/or theoretical robotics, with emphasis in robot locomotion
- Programming in C++, Python
- Working knowledge of ROS or ROS 2
- Working knowledge of modern robot simulation tools

We offer

- 4-year PhD position in a bioinspired robotics group in Estonia with 15+ years' experience in international and national funded projects
- The chance to do high-level research and collaborate with experts in one of the most challenging robotics fields, in the context of an upcoming EU funded project
- 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 median wage in Estonia (2500€ gross).

About the department

The Centre for Biorobotics (<https://taltech.ee/en/biorobotics>) specializes in research and development of robotics and sensing. On the robotics side, we are focusing on development of locomotion and control in underwater and multi-phase environments, where conventional terrestrial and underwater platforms are underperforming. In connection with robotics, we are focusing on developing 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 the bioinspired sensing methods in water flow sensing in natural environments (rivers, coasts etc.).

Our core competences are as follows:

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

Some of our research activities include:

- 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
- 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

(Additional information)



For further information, please contact Prof. Maarja Kruusmaa (maarja.kruusmaa@taltech.ee), Dr. Roza Gkliva (roza.gkliva@taltech.ee), or visit <https://taltech.ee/en/biorobotics>



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