

Rugged robots for locomotion in pipes

Summary

This PhD project will develop robot locomotion concepts for the upcoming EU-funded project PIPEON, which will investigate methods for performing inspection and maintenance tasks in sewer pipes. In particular, the aim is developing robot locomotion mechanisms, rugged-by-design, for an abrasive and corrosive environment, capable of operation on dry/wet surfaces, submerged conditions, and travel in or over soft mixed matter.

Research field:	Information and communication technology
Supervisors:	Prof. Dr. Maarja Kruusmaa Dr. Asko Ristolainen
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Computer Systems
Application deadline:	Applications are accepted between October 01, 2024 00:00 and October 25, 2024 23:59 (Europe/Zurich)

Description

The research

Performing tasks that are dangerous for humans in places difficult to reach is one of the main reasons for the rapid development of robotics in recent years. However, robot locomotion in unstructured and dirty environments is still a challenging task that can greatly reduce the range of robots and impede their performance. One of the most challenging environments is a sewer system. Hence, there is a need to design locomotion mechanisms for robots moving in mixed environments (mixtures of solids, liquid and gases) with varying properties that move over or penetrate through the medium. Locomotion will be combined with sensing and feedback control to adjust the robot to the properties of the environment by sensing traction, friction and suction forces and stiffness of the medium. An extra requirement is integration of the robot with a manipulator in a close cooperation with an industrial partner.

Automation of sewage maintenance and inspections have high commercial and economic potential. Throughout the robot development work the candidate is expected to explore its commercialization possibilities and work with industrial partners and end-users to find exploitation opportunities.

The candidate works in an international project with 14 partners (academic, industrial and public) and the work follows a workplan with those partners up to integration, testing and validation.

Responsibilities and (foreseen) tasks

- Design and development of rugged locomotion mechanisms for multiphase environments (mixture of solids, liquids and gases)
- Building robot prototypes
- Integration of robot locomotion and manipulation is a close cooperation with an industrial partner.
- Testing novel locomotion mechanisms in simulations, lab and outdoor environments
- Development / implementation of low-level control methods for locomotion, incorporating sensing where appropriate
- Publishing achieved results in (Q1) journals and top conferences of the robotics field

Applicants should fulfill the following requirements:

- A master's degree in robotics-related engineering discipline with mechanics training (e.g., mechanical engineering)
- A clear interest in the topic of the position
- Interest in commercialization, interest in creating social and economic impact of academic work



- 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:

- Background in mechanical engineering and robotics
- Experience with experimental and/or theoretical robotics concepts
- Programming in C, C++, python
- Working knowledge of ROS or ROS 2, MATLAB
- Working knowledge of CAD and FEA software
- Understanding of IP and commercialization of technologies

We offer:

- 4-year PhD position in one of the only bioinspired robotics groups 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 starting from 2300€ gross.

About the department

The Centre for Biorobotics specializes in research and development of underwater robotics and sensing. On the robotics side, we are focusing on development of locomotion and control in underwater and multiphase 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 multiphase 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 Dr. Asko Ristolainen (asko.ristolainen@taltech.ee), Prof. Maarja Kruusmaa (maarja.kruusmaa@taltech.ee), or visit <https://taltech.ee/en/biorobotics>



To get more information or to apply online, visit <https://taltech.glowbase.com/positions/850> or scan the the code on the left with your smartphone.