Rugged robots for locomotion in pipes

Summary:

This PhD project will develop the locomotion method for a rugged-by-design robot that can move in abrasive and corrosive, dry and submerged environments, in or over soft terrains. Candidates from robotics-related disciplines with mechanics background are invited to apply.

The work will be part of the ongoing EU-funded project PIPEON, which will investigate robotics and AI for inspection and maintenance of sewer pipes.
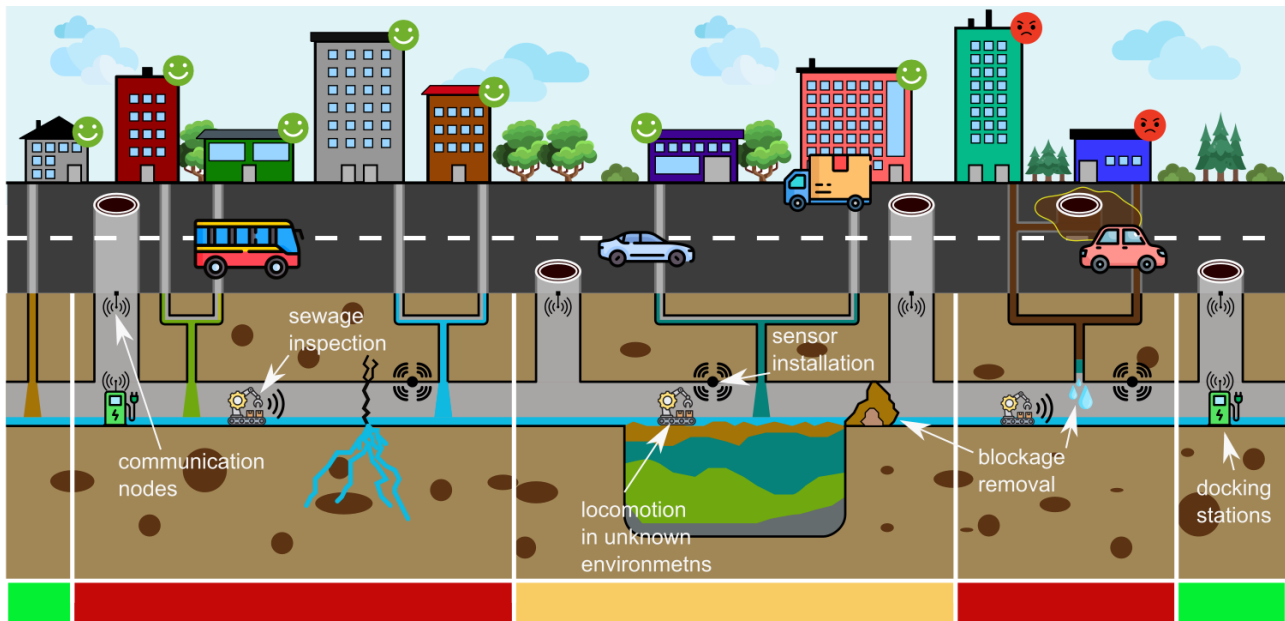
Figure 1 PIPEON project general concept – a step-change towards autonomous sewage maintenance

Description:

The research

Robust 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 and have to adjust their locomotion when the environment properties change.

This project will produce a robust locomotion system for a robot that will transport sensors and a manipulator for obstruction removal and sensor installation in sewage pipes. During the PhD, the candidate will design, fabricate, and evaluate locomotion prototypes for this robot. The development will consist of several stages of mechanical design, modelling, prototyping and fabrication, evaluation in simulation and with physical prototypes. A holistic approach will be followed, to design the locomotion system together with the whole robot body, taking into account the manipulation requirements, as well as the target 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, as well as commercialization of the prototypes.

Responsibilities

- 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 and implementation of low-level control methods for locomotion, incorporating sensing where appropriate
- 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 mechanics (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
- Working knowledge of CAD and FEA software
- Experience in experimental and/or theoretical robotics concepts
- Programming in C++, Python
- Working knowledge of ROS or ROS 2
- Understanding of IP and commercialization of technologies

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 (2300€ gross).

About the department

The Centre for 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 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

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