

Perception methods to enhance situational awareness of manned/unmanned surface vessels

Summary

The PhD candidate is expected to develop marine (sea) environment perception methods for situational awareness of future autonomous surface vessels. It is required to devise novel solutions that can help interpret the environment for safer ship navigation using state-of-the-art deep learning models together with various environment sensing methods. Detection and recognition of diverse moving objects (ships, yachts, sailboats, etc.), stationary objects (buoy) and characterisation of different sea states (ice infested, breaking waves, etc.) are the vital features of situational awareness systems of the ships which need to be addressed in this research.

Research field:	Environmental, marine and coastal technology
Supervisors:	Kristjan Tabri Dr. Dhanushka Chamara Liyanage
Availability:	This position is available.
Offered by:	School of Engineering Kuressaare College
Application deadline:	Applications are accepted between January 01, 2025 00:00 and January 24, 2025 23:59 (Europe/Zurich)

Description

The research focuses on the development of novel solutions to expedite ship autonomy development. By using various sensing modalities, the aim is to research into state-of-the-art methods that can solve the ship perception problem under demanding sea conditions.

Thus far, maritime transport heavily depended on human capabilities in decision making with the help of marine sensors readouts, charts, etc. With the recent developments in deep learning, sophisticated intelligent vessels developments are making significant advances. As further advances are challenged by the inadequacy of situational awareness methods under demanding sea conditions for smart ships, it is vital to develop needy technologies. Combining long-range, short-range perception sub-systems with coarse and fine sensing methods, accurate situational awareness systems need to be developed. Environment perception with navigational inputs will lead to further development of simultaneous localisation and mapping algorithms for the surface vessels.

Machine vision incorporating RGB, thermal imaging, and perhaps spectral imaging could provide a significant amount of detailed visual picture which can characterise the surrounding by employing deep convolution neural network models. LiDARs, RADARs, AIS equipment could further augment the perception by adding more details about the objects in the environment. ROS (Robot Operating System) provides a comprehensive array of tools that can easily implement required signal processing algorithms. Optimising those algorithms to run on embedded Linux devices is an essential step in implementing and conducting field tests for validation of the outcomes.

Tasks

- Develop sea-state characterisation methods.
- Develop navigational algorithms with multi-objective optimisation.
- Plan and carryout experiments to validate the developed perception methods in virtual and or real physical environments.

Requirements

The call is open for candidates with relevant backgrounds who fulfils the following requirements.

- A master's degree in mechanical engineering, mechatronics, electrical engineering, computer science or a related discipline.
- Should possess a strong command in Python, C++, and C# programming languages.
- Prior experience on computer/machine vision projects using computer vision libraries (OpenCV), machine learning frameworks (Pytorch and Tensorflow)

- Good understanding of ROS, ROS2 (Robot Operating System) and ability to work in Linux environments.
- Competent in developing mechatronics systems by integrating various sensors.
- It would be highly desirable to have a good understanding of Point Cloud Libraries for LiDAR data processing.
- Excellent academic writing skills with proven record of scientific publications in high-impact journals and conferences.
- Ability to work as an independent researcher.
- Must meet the requirements for doctoral students at the Tallinn University of Technology (<https://taltech.ee/en/phd-admission>).

During the assessment, emphasis will be put on the candidate's potential for research, motivation, and personal suitability for the position.

We offer

- Collaborate and engage with developing autonomous technologies. Access to the actual field data from autonomous platforms.
- Access to research infrastructure, sensors, and autonomous platforms.
- Opportunities for visiting conferences, research stays, and networking with globally leading universities and research centres.

Employment

The position is offered by the Marine Technology Competence Centre of Kuressaare College, which belongs to the School of Engineering of the Tallinn University of Technology. The expected duration of doctoral studies is four years. Following the standard practice in the School of Engineering, the contract will be made initially for one year, then it will be extended further after a successful progress review. The salary is according to the salary system of the Tallinn University of Technology.

The position will be fulfilled as soon as a suitable candidate is found. TalTech reserves the right for justified reasons to leave the position open or to extend the application period.

How to apply for a doctoral candidate position

Please read the admission guidelines at <https://taltech.ee/en/phd-admission>.

Further information

- Job location: Kuressaare & Tallinn, Estonia.
- For additional information, please contact
Dhanushka Liyanage (email: dhanushka.liyanage@taltech.ee), or
Kristjan Tabri (email: kristjan.tabri@taltech.ee)



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