Motion control system for (unmanned) surface vessels and platforms

Summary

In this position, you develop an active motion control systems for (unmanned) surface vessels and structures. Aim of the control systems is to actively damp the angular motions of the vessel based on the identified wave/ environmental conditions and the feedback from ship's response.

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 June 01, 2024 00:00 and June 30, 2024 23:59 (Europe/Zurich)

Description

The project focuses on the generic-level assessment of the controlled stabilization of angular motions of floating surface platforms such as unmanned monitoring vessels, floating wind turbines, hydrogen production units etc. Stabilization is necessary to expand the operational window of vessels and floating structures (e.g. smaller unmanned monitoring vessel requires roll stabilization to have comparable operational window compared to much larger manned vessel.) Several stabilization systems are to be considered and their suitability assessed: gyroscopes, reaction wheels, active fin stabilizers, gimbal, thrusters etc.

The proposed stabilizing system differs from traditional gyroscope-based systems by utilizing real-time data from a situational awareness module to respond to current wave conditions and individual disturbances. This data includes identified incoming waves and immediate feedback from the ship's roll motions. A behaviora lmodel of the vessel is used to predict the angular response under these environmental conditions. If the response exceeds the predetermined limits, the control module will initiate compensatory measures to bring the vessel's response back within the allowed range.

It is foreseen that the ship's behavioral model and stabilizing systems' actions are to be assessed either in (i) a semi-analytical or numerical model including the description of the environmental loads and structural response, or in (ii) a machine-learning model, where experimental or numerical simulation data is used to develop a model for structure's response. Digital Twin of the structure will be developed to predict and optimize its behavior. Cooperation with fellow doctoral students is foreseen to develop the behavioral model of the vessel.

PhD project includes the production of the stabilizing system and the prototype test platform for experimental testing of selected stabilizer(s) in the model test basin or in actual operating environment.

Why is this research necessary

- Tightening environmental restrictions, demand for new energy sources, more extensive exploitation of maritime domain and the developments in blue economy sectors willintroduce new surface vessel concepts and worldwide, including also the Baltic Sea and Estonian waters.
- More advanced and efficient structures are to be developed for competitive and international maritime domain.
- Development in control technologies, automation and robotics allows to develop novel solutions to minimize the angular motions of the structures and thus, to expand the suitable weather window for their efficient operation and to reduce the submerged volume required to fulfil the stability criteria.
- New structural concepts and configurations cannot always be assessed using conventional simplified models. Thus, more universal approaches and tools are required.
- The goals of the research correspond with the priorities of the EU (greener and safer surface transport, sustainable energy resources).

Requirements & Qualifications

The call is open for candidates with a wide range of backgrounds inside and outside of Estonia. Most importantly, high level of interest and motivation towards, and deep understanding on, computational mechanics and mechatronics is required. A suitable background may come from mechanical engineering, marine engineering, mechatronics, engineering physics, applied or computational mechanics, or related disciplines. Prior experience on working with dedicated seakeeping (e.g.HyrdoMax), computational fluid dynamics (e.g. StarCCM+) or finite element (e.g. LS.Dyna) softwares is a significant advantage as well as skills with programming tools such as Matlab, Python or Fortran. The candidate should prove his/her capabilities in writing the technical report and scientific papers in high quality journals. The applicant for the position must have a Master's degree and must fulfil the requirements for doctoral students at the Tallinn University of Technology (https://taltech.ee/en/phdadmission).

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

Employment

The position is at the School of Engineering at 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 extended after a successful progress review. The salaryis according to the salary system of 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 locations Kuressaare Tallinn, Estonia.

For additional information, please contact Associate Professor Kristjan Tabri (email:kristjan.tabri@taltech.ee).

To get more information or to apply online, visit https://taltech.glowbase.com/positions/775 or scan the the code on the left with your smartphone.