

**Vacancy:** PhD Candidate at the NTNU Centre for Autonomous Marine Operations and Systems (AMOS)

**About this position**

The NTNU Centre for Autonomous Marine Operations and Systems has a vacancy for a PhD Candidate related to the topic online risk management and modelling, maintenance and operational constraints of autonomous ships.

Autonomous ships are expected to improve safety and environmental impact at sea and reduce the number of human injuries and fatalities. The advancements in the technological systems onboard, the operations, and the interactions with the environment, however, may increase interlocks, complexities and hazards that are hard to identify, assess, and control. Without proper safety and security measures, the risk related to autonomous ships may not be found acceptable by the regulatory bodies and the society.

Even more complex power and propulsion systems will be installed in autonomous ships. If personnel are not onboard to operate, the ship needs to have safe and reliable onboard systems with high availability to be able to maneuver safely in the seaway. Shutting down and remobilizing the ship operation due to hazards caused by autonomous systems are not economically viable, nor acceptable from a risk perspective.

Increased Level of Autonomy in complex maritime operations may support the human operator in supervision and decision-making and reduce human workload. With reduced human operator intervention, and eventually presence onboard, it is important to improve the situation awareness for both the autonomous ship and the operator, and provide early warnings of potential deviations outside the operating envelope to enable reconfiguration of the system and implement risk reducing measures.

Autonomous ships require extensive situation awareness based on advanced sensors scanning the environment for obstacles, and fault detection and diagnosis of on-board systems. Challenges are sensor fusion, collision avoidance, decision under uncertainty, intelligent supervisory control, real-time processing and analysis of large amounts of data, fault-tolerant energy management of hybrid marine power plants, and risk and maintenance management. Research challenges include methods and strategies for safe and reliable performance to ensure that the autonomous systems comply with requirements. The research study for the available PhD position is on the development of methods for online risk management and modelling for supervisory control, maintenance and operational constraints for autonomous ships.

**Purpose**

This project will develop novel technological solutions for online risk management and risk control of autonomous ships. Cutting-edge interdisciplinary research combining cybernetics and risk management aims to achieve high level of autonomy, intelligence and decision-making capabilities for autonomous ships. The goal is to enhance the realization of autonomous ships by developing safer and smarter automatic sailing systems and power and propulsion systems that are able to detect, perceive, verify, monitor, control and follow-up deviations and potential hazards.