Mårten Lager, Thesis in Computer Science
Defence: Monday, February 4th, at 10.15 in E:1406 in E building of LTH, Lund.

Title:
Smart Technologies for Unmanned Surface Vessels - On the Path Towards Full Automation

Abstract:
As for the automotive industry, large efforts are being made by industry and academia to create autonomous ships. The solutions for this is very technology-intense, as many building blocks, often relying on AI technology, need to work together to create a complete system that is safe and reliable to use. Even when the ships are fully unmanned, humans are still foreseen to guide the ships when unknown situations arise. This will be done through teleoperation systems.

In this thesis, methods are presented to enhance the capability of two building blocks that are important for autonomous ships; a positioning system, and a system for remote supervision.

The positioning system has been constructed to not rely on GPS (Global Positioning System), as this system can be jammed or be spoofed. Instead, it uses Bayesian calculations to compare the bottom depth and magnetic field measurements with known sea charts and magnetic field maps, in order to estimate the position. State-of-the-art techniques for this method normally use low-accuracy navigation sensors and high-resolution maps. The problem is that there are hardly any high-resolution maps available in the world, hence we present a method of the opposite; namely using high-accuracy navigation sensors and low-resolution maps (normal sea charts). The results from a 20h test-run gave a mean position error of 10.2m, which would in most cases be accurate enough for navigation purpose.

In the second building block, we investigated, how 3D and VR approaches could support the remote operation of unmanned ships with a low bandwidth connection, by comparing respective GUIs with a Baseline GUI following the currently applied interfaces in such contexts. Our findings show, that both the 3D and VR approaches outperform the traditional approach significantly. We found the 3D GUI and VR GUI users to be better at reacting to potentially dangerous situations compared to the Baseline GUI users, and they could keep track of the surroundings more accurately.