Making ship systems smarter with simulation

As researchers deepen their understanding of autonomous and remote vessel operations, a new breed of smart ship systems combining simulation capability and artificial intelligence is emerging.

One of the biggest debates around the future of shipping is what role, if any, unmanned vessels will play. The journey may turn out to be more important than the destination: the pursuit of vessel autonomy is already leading to smarter systems that can enhance safety, cost-efficiency, and environmental performance even on today's vessels. Simulation technology is playing a key role in their development.

"We have a vision of a more efficient, more connected, smart marine ecosystem," said Neil Bennett, global director of Simulation at Wärtsilä Voyage. "Being part of the development of autonomous shipping is fundamental to shaping that future."

Simulation is integral to developing autonomous systems. The computer models that underpin simulation-based training – capable of replicating almost infinite permutations of marine environments, vessel traffic situations, and ship equipment – are the same that are used to inform the decision-making capabilities of intelligent systems. Deployed in real time with real people in simulators, those same models can be used to test and validate the human-machine interface and, eventually, to teach the crew how to use those systems.

Three projects at Solent University, Southampton in the UK highlight the diverse roles that simulation plays. The university's research staff in the Warsash School of Maritime Science and Engineering recently participated in the MAXCMAS project – a GBP 1.4 mn, two-year project in which autonomous vessels were programmed to obey maritime regulations for the avoidance of collisions. The project tested the algorithms it had developed by modelling scenarios using simulation before a live trial was conducted onboard an autonomous minesweeping vessel in Weymouth Bay.

Building in seamanship

Preparing vessels to obey regulations written with human seafarers in mind is not a simple task, explained Terry Mills, senior simulation technician at Solent University, Southampton. "The regulations are well written, but are always open to interpretation. And the interpreter is a human. A machine sees rules in black and white, so we had to build in seamanship. We ended up with a set of algorithms and an interface that could be retrofitted to any size of ship."

A much larger project was the Europe-wide, EUR 43 mn, Sea Traffic Management initiative. Ten simulator training centres – the European Maritime Simulator Network – worked together with the goal of understanding and then facilitating the kind of data exchange that will be crucial for safely operating autonomous vessels.

Wärtsilä, as a simulation provider, took part in this project, which Mr Mills describes as an attempt to establish "air traffic control at sea." One key goal was understanding the data sharing needed between ports, vessels, and other stakeholders – such as ship service providers and onward logistics companies – to enable "just-in-time" sailing.

Three hundred vessels were fitted with tools to collect and transfer data. Studying interactions between these vessels provided important insights into how sea traffic could be better managed to optimise vessel voyages and port calls – reducing fuel cost and emissions. But even with so many vessels participating, the number of times ships would meet each other physically would have been rather limited. With the help of the simulator network, they met

Simulation is integral to developing autonomous systems. Image courtesy of Satakunta University of Applied Sciences (SAMK).

virtually, giving researchers the opportunity to collect more data faster.

Remote control training

A new potential project builds on Solent's strong previous experience in remote and autonomous ship systems. The university is bidding for funding to extend its investigations into training seafarers in remote operations. The project aims to link Warsash's simulation centre with one of the scale models it currently uses for ship handling training at a dedicated facility, Timsbury Lake. By using a simulator programmed with a scale model of the vessel and the lake area to control a real vessel, the project will provide a more realistic training experience for remote seafarers.

"One of the biggest barriers to training for remote operations is the capacity to test on full-scale ships," said Mr Mills. "Using a real vessel would be expensive and dangerous if something went wrong. Simulations are great for learning pilot skills, but cannot provide that jeopardy."

The risk of putting a dent in one of the scale models on Timsbury Lake will provide that dose of realism. The fact that students will be operating manned models the same area will also allow researchers to study the interaction between remotely operated vessels and manned craft.

To assist in autonomous and advanced navigation projects such as these, Wärtsilä has created an open approach that makes it simpler for universities and research institutions to deploy its simulation technologies. While Wärtsilä often provides the hardware for such projects – including 3D screens and control units reproducing bridges – it is the software that is more critical. This includes the operating platform as well as models of sea areas and ship systems that can then be used in simulator rooms or fed into computers as needed.

One example is the Intelligent Shipping Technology Test Laboratory (ISTLAB) at the Satakunta University of Applied Sciences (SAMK) in Rauma, Finland. The lab, among the first of its kind, is designed as a testing environment for remotely controlled, autonomous vessels. Wärtsilä recently delivered a navigation simulator and specific mathematical models for the project. They will be used to carry out simulated testing of remote-controlled vessels

... University, Southampton. Image courtesy of Solent University.

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