First ever autonomous vessel trials held in the North Sea by a Dutch consortium

As part of the Autonomous Shipping JIP, which began in November 2017, a unique series of autonomous operations' trials were prepared in the MARIN bridge simulator and held at sea recently (see also pages 6-8). A number of challenging nautical scenarios were executed to determine how a vessel interacts with seagoing traffic.

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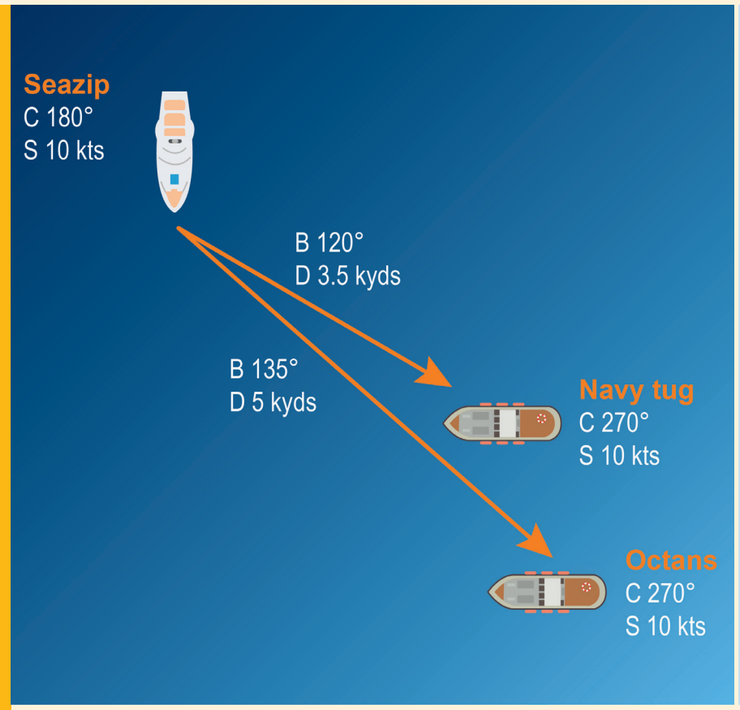

Figure 1 Typical 'open water' test scenario of more or less equally sized vessels

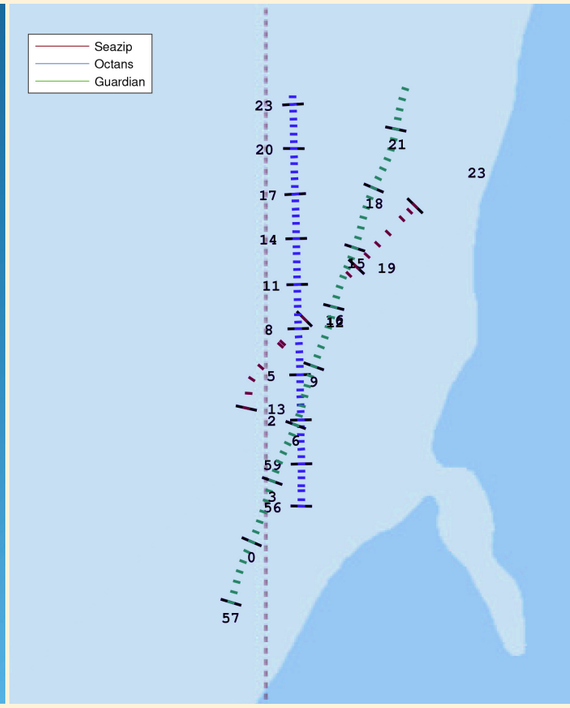

Figure 2 Scenario real-life run - third ship on port side, overtaking Seazip

Autonomous technology is expected to improve safety, reduce operating costs and enhance sustainability. On the road towards autonomous shipping, companies can adopt technology in support of the crew and that offers operators cost savings and increased operational security and safety. With 17 partners, the Autonomous Shipping JIP ultimately aims to create a national roadmap on autonomous technology, based on the identification of missing technologies. MARIN contributed to the issues of basic collision avoidance, modelling of good seamanship (COLREGS & more) and the safety assessment thereof by benchmark scenario building, simulator use and sea trials.

Research within the project was divided into several work packages executed by MARIN, Delft University of Technology and TNO. The latter performed a study on collection, processing and communication of data, while TU Delft investigated system safety and reliability, functional decomposition and ship design issues.

Testing on the MARIN bridge simulator The nautical benchmark scenarios were developed by MARIN and tested on our full mission bridge simulator. They examined the ability of a vessel to avoid contact and vessel collisions, whilst applying the rules of the road at sea (COLREGS) and good seamanship. To this end, the autonomous system, (provided by project partner Robosys), was connected to the bridge simulator next to other safety enhancing systems. These 'hardware in the loop' scenarios were then compared by nautical experts with the same 'captain in the loop' scenarios, leading to valuable assessment criteria and modifications of the software. At the same time, the simulator tests served as a release protocol for use of the system during trials at sea. Figure 1 shows a typical unrestricted water test scenario of more or less equally sized vessels.

Trials at sea In March, the consortium performed the first ever autonomous operations with seagoing vessels in the North Sea in an area west of Den Helder. The 'SeaZip 3', a Damen Fast Crew Supplier 2610 Twin Axe, operated by SeaZip Offshore Service was outfitted with collision avoidance technology. A total of 20 runs covering 11 challenging nautical scenarios were executed in which 'SeaZip 3' interacted with two other vessels; 'Octans', a training vessel of the Maritime Institute Willem Barentsz and 'Guardian', an Emergency Towage Vessel, operated by The Netherlands Coastguard. The Dutch government is also a partner and gave permission for the trials.

Traffic conflict solution The trials focused on the traffic conflict solution assessments and used radar data and AIS information as input to the autonomous system. The system output was sent to the onboard autopilot and main engine throttle control. By testing these scenarios, the partners are able to show the decision-making process of an autonomous system in ensuring safe sailing and avoiding collisions with other vessels.

These trials showed that most manoeuvres were completed and carried out in a safe manner. The algorithms performed best in the higher speed range. At lower speeds the ship system did not interact well with the autopilot. A more fundamental issue concerns the sequential handling of evasive manoeuvres. As yet, the systems behaviour does not yet match a human operator, who considers the overall picture and the development of the sometimes complex traffic pattern when taking action. The artificial intelligence strategy has to be developed further, as well as the capacity of the software to learn.

It was concluded that further development of autonomous systems is needed to cope with complex marine traffic situations including foul weather, traffic separation schemes and restricted waters. Following the trials many of the lessons learned have already been included in the autonomous system and successfully tested on MARIN's simulator.

This project contributes to the efforts of MARIN to develop a simulation environment for testing and the qualification of autonomous systems. The wider roadmap that is being developed shows an economically and technically feasible plan, that considers the many steps that need to be taken to achieve further automation and autonomy. For more information read the interview with Marnix Krikke from NMT (pages 6-8) and see www.marin.nl/jips/autonomous-shipping.

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