Tackling increasing cruise vessel dimensions in virtual reality

MARIN has performed simulator research and advanced simulator training for major cruise ship builder Meyer Werft to assist the yard with handling the ever-increasing size of newbuildings.

Training on the MARIN simulator bridge

Meyer Werft is one of the world's most successful builders of large cruise liners. Based in Papenburg in Germany, the yard is located along the Ems River.

After completion, the cruise ships make their way from Papenburg to Eemshaven navigating the narrow and winding river between Papenburg and Emden. The liners leave the shipyard's harbour through a narrow lock, therefore the ship/lock interactions play an important role. Additionally, the vessels pass two narrow bridges (at Weener and Leer) and the storm surge barrier ('Emssperwerk') at Gandersum.

Freek Verkerk
f.verkerk@marin.nl

The cruise ships start their journey sailing astern to enable the pilots to have a better orientation; looking from the port bridge wing astern along the superstructure. Sailing astern also enables the pods or propeller/rudder configuration to be in a safer, mid-river location and the small bow has more space to swing out. Moreover, if the strong bow construction touches the bank it will not directly lead to damage of the vessel.

Advanced training for pilots The Ems River pilots performing the conveyance follow an advanced training course at MARIN two or three weeks before the actual journey of each vessel.

As dimensions of the cruise ships built at the yard have continued to increase over the years, the manoeuvring margins in this part of the river are becoming smaller and smaller. This means that the hydrodynamic interaction between the ship's hull, pods or propeller/rudder configuration and riverbanks is playing an increasingly important role. As well as this, the available space for the assisting tugs decreases, therefore tugs towing on a line are not efficient anymore, especially when transiting bends. Working in close co-operation MARIN, Meyer Werft and the EMS Pilot Association have found solutions for both challenges.

Norwegian Bliss after turning at Emden, reality vs simulation

To reduce hydrodynamic interaction, the sailing speed had to be reduced and pod use had to be optimised. This was only possible by introducing a semi-rigid way for tug assistance. By fixing a tug to a pontoon at the bow of the vessel and a tug to the stern of the vessel, the required space reduces dramatically and the tug forces act directly on the vessel and without delay.

In this way the motions of the vessel can be controlled in the confined river channel much more accurately. Manoeuvring tasks and compensating wind forces are divided over the two tugs, the pods and bow thrusters. Splitting up these tasks makes it easier for the pilots to control the vessel. As three pilots sail the vessel, coordination of these separate tasks is of the utmost importance for a safe conveyance.

Optimum manoeuvring strategies
During several research projects carried out for planned new vessels being built at Meyer Werft, optimum manoeuvring strategies and sailing speed scenarios have been developed in close co-operation between MARIN and the EMS Pilots involved. The first part of the conveyance – lining up the vessel in front of the lock, passing through the lock to enter the river and navigating the first river bend – are particularly challenging. To accommodate the safe lining up of the cruise ship and passing through the lock, five rolling fenders have been placed along the eastern lock wall and one rolling fender at the west side of the entrance. During this stage the speed of the vessel is kept very low (0.1 to 0.2 kts) to avoid heavy impacts when landing on the fenders. The speed when navigating the lock is also kept very low to minimise a potential 'blockage' as the margins between the vessel's hull and fenders are not more than 1 metre on each side.

In addition to the research and training for regular activities, emergency situations have also been studied and training scenarios have been developed for these events. Due to the separation of the tasks it is easy to analyse the effects of a malfunction of a pod, bow thruster or one of the two tugs. Recently, the possibilities of executing the conveyance with one pod out of order have been studied. The wind limits and duration of the total conveyance with one pod out of action were determined. Research and training in virtual reality using simulators optimises the vessel's manoeuvres and improves safety and efficiency, especially when manoeuvring margins become extremely tight.