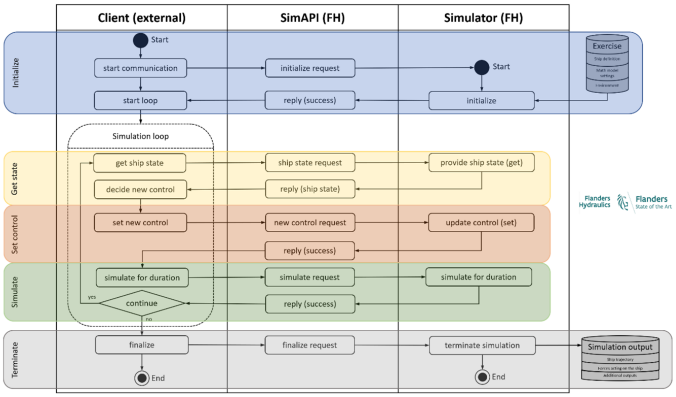
Knowledge Centre Manoeuvring in Shallow and Confined Water

Flanders Hydraulics | Flanders State of the Art | GHENT UNIVERSITY

June 2023

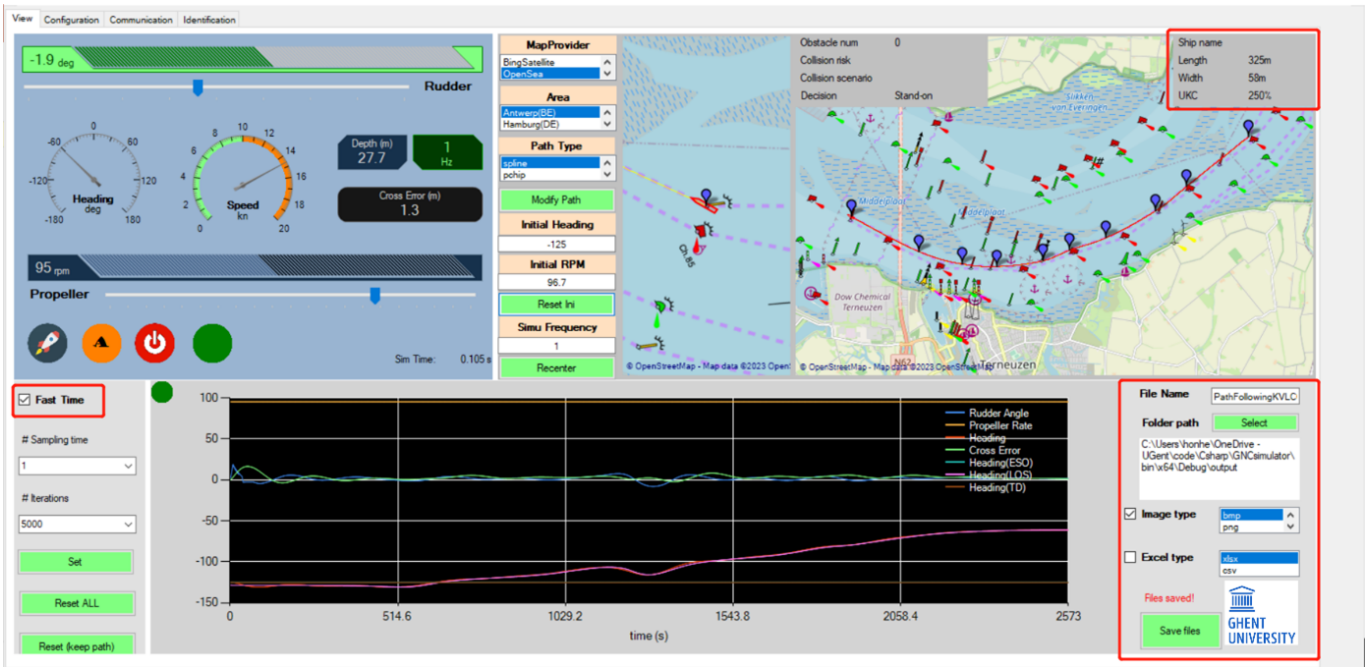
This is the 54th newsletter of the Knowledge Centre Manoeuvring in Shallow and Confined Water, which aims to consolidate, extend and disseminate knowledge on the behaviour of ships in shallow and confined water. In this newsletter, we present a virtual test bed for autonomous navigation that we developed, called 'SimAPI'.

SimAPI



Flanders Hydraulics has several full mission bridge simulators specifically devoted to ship manoeuvring in shallow and confined water. At the heart of the simulators, mathematical manoeuvring models account for the forces related to shallow water, banks, ship - ship interactions, locks, waves, wind and current and nautical bottom. The simulators can now also serve as a virtual test bed for autonomous navigation by interfacing (third-party) controllers via an Application Programming Interface. SimAPI is a .NET interface developed by FH that allows external applications to set up a simulation and take full control on the ship and the environment. By using SimAPI, an external client application can fully interact with the manoeuvring models of FH, providing control values and receiving the updated dynamic state of the ship. The dynamic state of the ship which is shared through SimAPI, includes the ship's position and velocity in six degrees of freedom, as well as the state of controllable ship components, like the propeller number of revolutions and the rudder angle. In addition, the dynamic state also includes parameters related to the environment such as water depth, current and wind condition.

SimAPI is also very flexible so that it can work easily with third party controllers. The interface is not bound to the time step of the simulators. The pace of the simulation, the frequency of control updates and the length of simulation blocks can be set arbitrarily to achieve the desired interaction between client code and the manoeuvring models behind the simulators of FH.



Researchers at the Maritime Technology Division at Ghent University were the first to integrate SimAPI in a front-end application, called 'SimAutoPilot', which provides different autonomous control algorithms to steer a ship on a track. The steering decisions of the front-end provide the rudder angle and propeller rate via SimAPI to the simulators. SimAPI then returns the ship motions which are determined by the advanced manoeuvring in conjunction with the environmental conditions. In the example shown here, a tanker sails in a waterway under the control of a Model Predictive Control path follower. This predictive model utilized in MPC is an identified ship model rather than the manoeuvring model in the simulator. Another demonstration showing a test of automated collision avoidance compliant with COLREGs can be seen via https://youtu.be/6Wkcq2uELDY.

Researchers associated with the Knowledge centre recently published:

Chen, C.; Lataire, E.; Delefortrie, G. (2023). Experimental study of adaptive course controllers with nonlinear modulators for surface ships in shallow water. ISA Trans. 134: 417–430. doi:10.1016/J.ISATRA.2022.08.005

Lataire, E.; Raza, A.; Vantorre, M.; Delefortrie, G. (2023). Boundary layer influence on ship model tests in extremely shallow and confined water. J. Hydrodyn. 2023. ISBN 4224102300240: 1–14. doi:10.1007/S42241-023-0024-0

Mansuy, M.; Candries, M.; Eloot, K.; Page S. (2023). Simulation Study to Assess the Effect of Ship Beam on the Navigable Flow Conditions in Paris. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, Vol. 17, No. 1, pp. 25-31. doi:10.12716/1001.17.01.01

Mansuy, M.; Candries, M.; Eloot, K. ; Page, S.; Adams, R.; Thorel, X.; Decroix, G. (2023). Optimized Turning Basin Design for Inland Waterways. J. Waterw. Port, Coastal, Ocean Eng. 149(4): 04023008. doi:10.1061/JWPED5.WWENG-1978

Activities

Jeroen Verwilligen attended ShipWave 2023, the 1st workshop on ship induced hydrodynamic loads on waterways that was organised by BAW and was held in Hamburg from 22 to 24 March 2023. Together with Dieter Meire (FH), he presented an "Analysis of ship waves along the Scheldt estuary".

Jeroen Verwilligen presented Flanders Hydraulics' Autonomous Ship Innovation Platform (AShip) at the MASS-session on 26 April 2023.

Researchers associated with the Knowledge Centre attended TransNav 2023, which was held in Gdynia from 21 to 23 June 2023. Hongwei He presented "A Ship Manoeuvring Desktop Simulator for Developing and Validating Autonomous Navigation Algorithms" and Marc Mansuy presented "Simulation Study to Assess the Effect of Ship Beam on the Navigable Flow Conditions in Paris".

Thibaut Van Zwijnsvoorde and José Villagomez represented the Knowledge Centre at the Autonomous Ship Technology Symposium, which was held at the Autonomous Ship Expo and Conference 2023 in Amsterdam from 21 to 23 June 2023.

Over the summer, Katrien Eloot will attend the third SIMMAN workshop, which will be held in Songdo from 17 to 19 July 2023.

Remora

It is not very often that research that has been presented at a MASHCON conference gets published in a series of historical studies. The book will be published in August 2023 and tells you how a tiny fish affects the manoeuvrability of ships, playing a decisive role in the Battle of Actium and explaining the defeat of Antony and Cleopatra against Octavian. The research was carried out by a multi-disciplinary French team. CNRS also has a post-doctoral position available to carry out research on river navigation in a confined environment.

Knowledge Centre Manoeuvring in Shallow and Confined Water
Berchemlei 115
2140 Antwerp
Belgium
T. +32 3 224 60 35

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