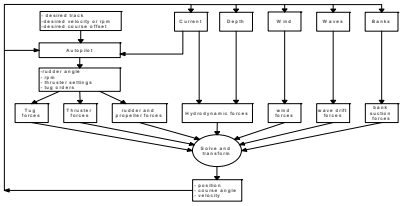
Design evaluation by scenario simulation

The art of ship design is to find the best design compromise suitable for the ship's task and its operations, taking the performance, initial costs, safety and running costs into consideration. Decisive design compromises are made in the early conceptual design phase, but the impact of these decisions on the mission of the ship is not always fully understood. Consequently, all issues, constructive and hydrodynamical, governing the ship design, should be assessed in this initial design phase. For design optimisations and new concept development a thorough hydrodynamic assessment is required to evaluate the applicability of for example the hull design or different propulsion arrangements related to the mission and operational requirements of the ship. MARIN's numerical aids facilitate the assessment of the manoeuvring performance of the vessel in general but especially focussed on real life operational scenarios.



Flow diagram of the SHIPMA model

Approach

The prediction models can be derived from:

- Empirical data, e.g. MARIN's SurSim [1]
- Reference vessels
- Model tests

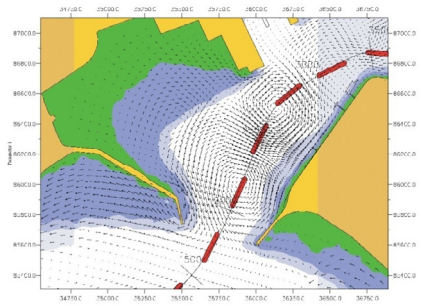
Information gathered from emperical and/or experiments are:

- Hydrodynamic manoeuvring derivatives (deep and/or shallow water)
- 2nd order wave drift forces
- Wind forces
- Bank suction effects

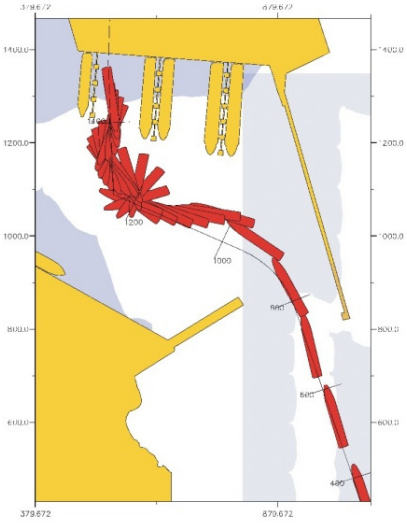
General manoeuvring characteristics of different ship or propulsion concepts can be studied based on the empirical data or model tests directly. Dedicated scenario simulations can be performed using ShipMa.

Introduction ShipMa

The latest version of the fast–time simulation program ShipMa is a joint development of MARIN and WL|Delft Hydraulics. In ShipMa the vessels are steered by an autopilot which is capable of operating in the track-keeping mode and in the harbour-manoeuvring mode. The flow diagram gives an overview of the program structure. The simulations give insight into the inherent possibilities and/or restrictions of vessels, infrastructure and environmental conditions. It may include the effect of additional manoeuvring devices like bow- and stern thrusters and the role of tugs. Environmental conditions can be modelled by wind coefficients; bank suction coefficients, 2nd order wave drift forces and shallow water effects. In the final stage of the design the ShipMa study can be followed by a study on a real-time simulator.



Entrance manoeuvre



Berthing manoeuvre

References:

[1] SurSim, Computer Program for the calculation hydrodynamic reaction forces, MARIN.

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SHIPMA input and output

Input:

- Scenario data (Harbour approach and berthing manoeuvre)
- Hydrodynamic ship model of the vessel
- Environmental conditions:
  - bathymetry
  - current pattern
  - wind field
  - wave field

Output:

- Track, position, course and heading of the ship, also relative to the desired course/track
- Steering angle and number of propeller revolutions
- Water depth at the centre of gravity
- Wind and waves: direction, velocity/height and forces acting on the ship
- Current velocities on the ship
- Bank suction forces

Typical scenario simulations, presented in a bird's eye view plots are presented in the graphs on this page.

Expert report

An assessment of the manoeuvring characteristics will be made based on the general knowledge and the results of the dedicated scenario simulations. The overall evaluation is focussed on:

- Viability of the concept during real life operations
- Efficiency, impact of different concepts on economical issues, e.g. fuel consumption and downtime
- Operational safety of the concept

The study may be focussed or extended on relevant issues for the concept at hand.