Copy of SHIPMA Documentation Home

This documentation relates to version 6.0

If you are using an earlier version, please view the previous versions of SHIPMA documentation and select the relevant version.

This is the home of the SHIPMA documentation.

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Product information for SHIPMA

Introduction SHIPMA model (version 6)

The latest version of the fast–time simulation program SHIPMA is a joint development of MARIN’s nautical centre MSCN and WL| Delft Hydraulics. The combined contribution of these institutes leads to a fit for purpose program to simulate the manoeuvring behaviour of vessels in ports and fairways.

In SHIPMA the vessels are steered by an autopilot which is capable of operating in the track keeping mode and the harbour manoeuvring mode, making it possible to perform typical harbour manoeuvres like turning, reverse sailing and berthing.

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SHIPMA applications

The application of SHIPMA is primarily in port and fairway design, referring to both approach channels and inland waterways. According to PIANC [1] a first estimate of the required channel width based on their methodology (computerised version freely available at MARIN/MSCN) has to be followed by ship manoeuvring simulations.
These simulations give insight into the inherent possibilities and/or restrictions of vessels, infrastructure and environmental conditions including the effect of additional manoeuvring devices like bow and stern thrusters and the role of tugs. Based on the insights gained, mitigations, if needed, of the infrastructure design (channel layout, manoeuvring basin and terminal layout) and/or the admittance policy can be proposed. In the final stage of the design the SHIPMA study can be followed by a study on a real-time simulator. The flow diagram on the next page gives an overview of the program structure.

Methodology of SHIPMA use

SHIPMA relies on the use of an autopilot, which also includes a tug allocation algorithm. The choice for using an autopilot rather than hands-on steering by a pilot or Master allows the engineer to clearly judge and compare the results of different simulations on technical and physical aspects. The use of an automatic pilot in desktop simulation assures repeatability and a consistent nautical assessment procedure. The hands-on mode often seen in other models (actively steering the ship over a chart displayed on a screen) would put a civil engineer in a position where he is in fact playing the role of a pilot or Master. Alternatively, one could ask a pilot to do the runs, but the chart display offered to him is rather different from his normal sailing practice. This will jeopardise the result of the manoeuvres. Furthermore, runs have to be repeated to guarantee consistency.

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Ship characteristics

The mathematical ship models, consisting of sets of hydrodynamic derivatives (Abkowitz type [2]), are specific for each ship. They are determined either by scale model test, through scaling from other models or by calculation (SURSIM [3]). Models can be chosen from an existing list of over 100 high-quality ship models covering the latest ship designs. Specific models can be made according to the client's wishes. The models include wind coefficients, bank suction coefficients, second order wave drift forces and shallow water effects.

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Example of an entry manoeuvre into the 'Sloehaven' Flushing, with an airialview of the port

SHIPMA input and output

The input of the SHIPMA model is organised through the 'case management tool'. This tool guides the user through the preparation and execution of a simulation. The input of the model is organised in a number of files:

- A file containing data concerning the manoeuvre, desired track, setting of autopilot, time step, starting position, tugs etc.
- Files in which the ship is represented by dimensions, mass, windage area, etc. and the manoeuvring characteristics of the ship, to be expressed in hydrodynamic derivatives.
- Files to describe several external conditions such as:
  - bottom level,
  - current pattern,
  - wind field,
  - wave field.

Note that for this type of data the number of grid points is practically unlimited, and that data from other mathematical models can be used easily.

The main output consists of:

- track, position, course and heading of the ship,
- course deviation and distance to the desired track,
- rudder angle and number of propeller revolutions,
- for wind and waves: direction, velocity/height and forces acting,
- on the ship,
- water depth at the centre of gravity,
- current velocities on the ship,
- bank suction forces,
- tug forces.

The track and the output data can be plotted using DELFT-GPP.

Examples

Included are two examples of a computation with the new SHIPMA model. The first example (see previous page) shows an entry manoeuvre into the 'Sloehaven', Flushing. The manoeuvre is executed under maximum current conditions, the current is computed with the delft3d-flow model and imported in SHIPMA, together with bathymetry and the results of wave penetration calculations. The 2 plots at the right show an example of an entry and berthing manoeuvre with a twin propeller twin rudder vessel equipped with a bow thruster.

Track plot and Data plot (forward speed, sideward speed and rudder angle)

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SHIPMA is also capable of simulating inland waterway situations (picture left). Mathematical models are available for various types of ships. The algorithm for simulating tug assistance has been improved considerably. Tugs are capable of controlling the ship speed in combination with the track keeping mode (picture right).

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Computer requirements

- Pentium processor (300Mhz)
- 64 Mb memory
- 75 Mb disk space
- Operating system (Windows 95 or higher).

References

[1] PIANC-IAPH Working Group II-30, APPROACH CHANNELS A guide for Design.
[2] Abkowitz, M.A., Lectures on ship hydrodynamics, steering and manoeuvrability, Hydro- and Aerodynamics Laboratory, Rep. No. HY-5, 1962. Copenhagen, Denmark.
[3] SURSIM, Computer Program for the calculation hydrodynamic reaction forces, MARIN.

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