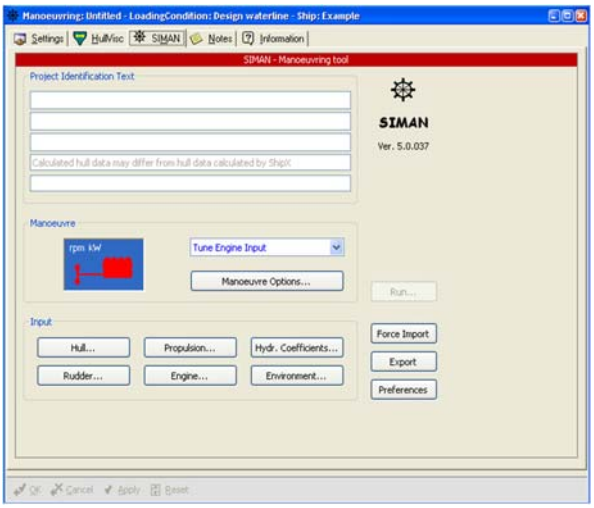
ShipX Manoeuvring

A Manoeuvring Prediction Program For The Early Design Stage

SINTEF Ocean has developed a program for numerical calculation of manoeuvring performance of conventional deplacement ships. The program requires a minimum of input, hence it is very well suited to be used in the early design phase. The program is integrated in the hydrodynamic workbench ShipX.

The International Maritime Organization (IMO) has proposed standards for the manoeuvrability of ships as part of its effort to increase the safety of traffic at sea. The background for the introduction of the IMO standards is the increasing number of ships in operation with hull form and hull proportions that may lead to inadequate steering and manoeuvring characteristics. Transportation of dangerous cargoes in densely populated areas, larger ships being introduced to existing harbours, and more frequent rotation of ships' crews are also reasons for introducing manoeuvring standards, with the expectation that this will lead to ships that are easier to handle and whose manoeuvring characteristics are more uniform.



The IMO standard in its present form addresses the following manoeuvring characteristics and defines criteria for them:

- Course stability
- The ability to commence turning
- The ability to check a turn
- Stopping ability with engine full astern.

Compliance of a new ship design with the IMO standards should be evaluated in the early design stage when changes to the design can be made at low cost. This requires a reliable and easy to use calculation and prediction tool.

NUMERICAL METHODS

The calculations are based on information available to a ship designer in the early stage of his work. The input data are grouped in five main sections:

Hull description including main dimensions, body plan, bow and stern contours, and propeller and rudder arrangement.

Rudder description including dimensions, type and location.

Propeller description including dimensions, pitch ratio, blade area ratio and location.

Propulsion engine description including engine type. The choice of engine type is restricted to directly coupled diesel engine characteristics or constant rate of revolution in the manoeuvre.

Hydrodynamic coefficients including added mass, linear damping and non-linear damping.

Environmental forces including wind, wave drift, current and the effect of limited water depth.

SUPPORTED MANOEUVRES

All manoeuvres specified by the IMO standards can be predicted in addition to some other manoeuvres. The following manoeuvres can be calculated:

- Sailing on straight course (normally used to adjust rpm and speed)
- Turning circle
- Zig-zag
- Direct spiral
- Reverse spiral
- Complete spiral test
- Full astern stopping
- Full ahead start
- Controller mode
- Real time simulation

SUPPORTED CONFIGURATIONS

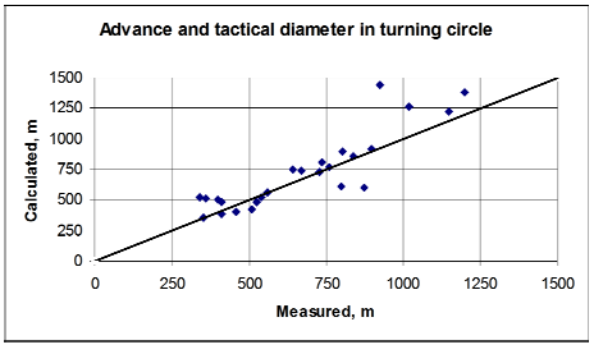
The following configurations are supported:

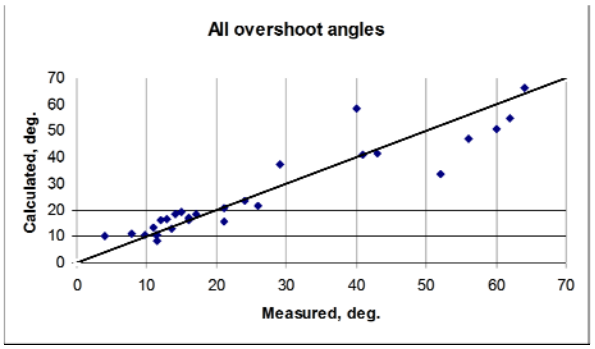
- Single /twin screw conventional merchant displacement vessels
- Includes different types of high lift rudders, as well as provide the opportunity for the user to run the calculation for specified rudder characteristics
- Tunnel thruster in the bow and stern

Ability to calculate the effect of wind, current and wave drift force on the manoeuvring motions The output results are presented in tables and time series plots

RESULTS

The software gives results of acceptable accuracy for the range of hull forms from the slender type to the full type with conventional stern or pram stern. Below are two figures showing calculated values (blue markers) compared to full-scale measurements. The distance between the blue marker and the straight line indicate the error in the calculation. The upper figure compares the advance and tactical diameter (both are included in the IMO criteria) in a turning circle. The lower figure compares the overshoot angles (which are also included in the IMO criteria) in 10/10 and 20/20 zig-zag manoeuvres.





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