ShipX Ship Speed and Powering

Predicting Calm Water Resistance and Performance

SINTEF Ocean has developed a program for numerical calculation of ship resistance in calm water and speed loss in waves. 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 motivation for developing this software was to enable the ShipX workbench environment to provide the user with the ability to calculate calm water performance as well as speed loss in waves within one product. Both of these features were implemented in the ShipX Plug-In "Ship Speed and Powering". The Plug-In is based on the work behind the SINTEF Ocean products EmPower (calm water resistance and propulsion) and Seaway (speed loss in a seaway).

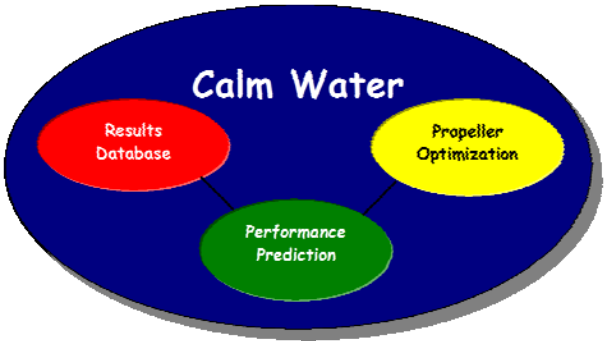
The calm water part of the program, based on EmPower, is designed to predict resistance and performance for conventional ships. EmPower was based on SINTEF Oceans resistance and propulsion database, and other prognosis tools developed at SINTEF Ocean. Further development and customisation of EmPower was conducted as part of later research projects. The program includes an option to include a results database of model tests (optional). The customers then receive a database containing their own model test results from SINTEF Ocean. Import and export functions makes it easy to add new results from model tests at SINTEF Ocean.

The following calculation methods are available for resistance and propulsion data:

- Direct input of residual resistance and propulsive coefficients from model tests or calculations.
- Residual resistance and propulsive coefficients derived from a search in the integrated database
- Residual resistance derived from a comparison ship, where the influence on CR on the difference between the actual ship and the reference ship is calculated using one of the three empirical methods described below.
- Holtrop 84 method.
- Model resistance based on Hollenbach 98
- Resistance regression derived from SINTEF Ocean database using Artificial Neural Network.
- Direct input of resistance curve.

Ship speed can be predicted by applying data from standard propeller series, including open and ducted propellers, as well as arbitrary open water curves that can easily be read into the program.

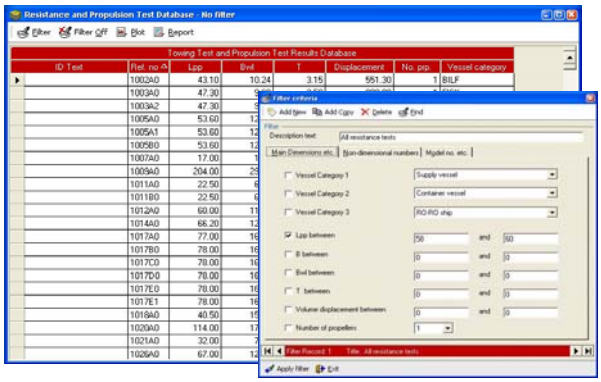
The calm water part of the Plug-In basically consists of three separate sub-programs or tools, which can be applied separately or together to obtain the information you need (see below figure).



RESULTS DATABASE

A database containing model test results of resistance and propulsion characteristics is included. The database functionality includes filtering of vessels with regard to various parameter ranges, such as vessel types, Lpp, L/B etc. in order to select a basis for a performance prognosis for a similar ship. In addition, various reports and plots can be generated based on the filtered vessels.

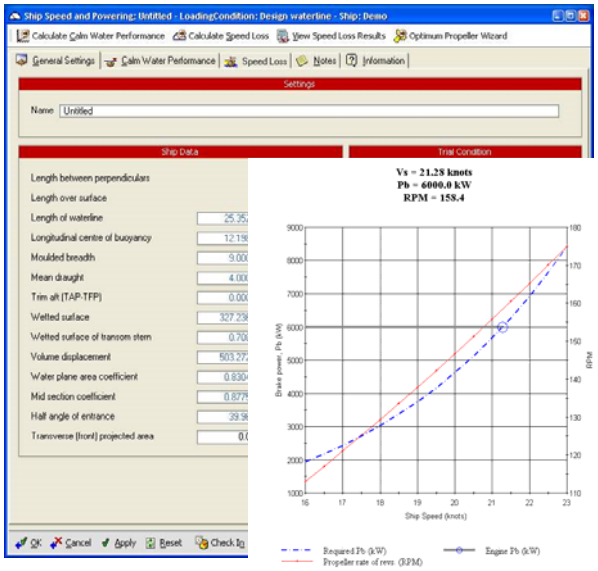
The plotting module in the database includes plotting the residuary resistance in a curve fitting toolbox, where a polynomial for the residuary resistance curve can be created and modified based on the filtered vessels. This polynomial can be applied in the performance prediction part of the program in order to perform performance predictions for a given set of ship data.



PERFORMANCE PREDICTION

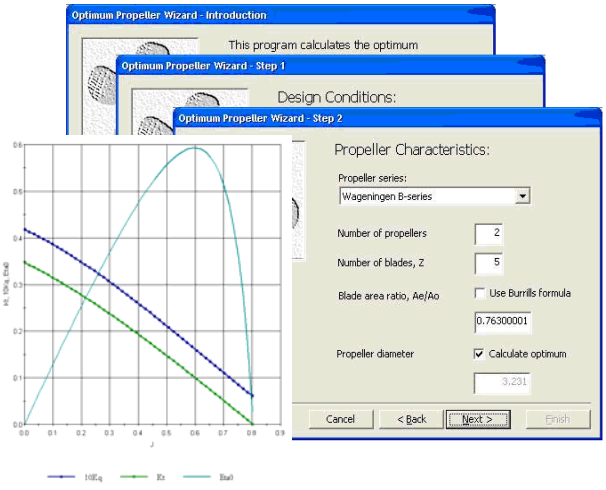
In addition to the database, there is also a performance prediction tool that can be applied to carry out performance predictions based on Holtrop's method, the Hollenbach 98 method, an Artificial Neural

Network regression based on the SINTEF Ocean database, or by specifying the resistance and propulsion data directly. In the latter case, the results database can be applied to find the necessary coefficients, such as residuary resistance and average propulsive coefficients. There is also a dialog where the required resistance curve polynomial can be constructed from input resistance data.



PROPELLER OPTIMIZATION

The third component that is included in the calm water part of the Plug-In, is a propeller optimization wizard, where the propeller diameter and/or pitch ratio can be optimized based on the engine and ship characteristics. As an alternative to the propeller wizard, the propeller characteristics in terms of an open water diagram can be input.



Together, these different sub-programs form a basis to carry out complete performance predictions of ships based on empirical and experimental data.

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