Empirical Power prediction program

EmPower is a Windows based program designed to predict resistance and performance for conventional ships.

The program is based on MARINTEK’s resistance and propulsion database, and other prognosis tools developed at MARINTEK. Further development and customisation has been conducted as part of the SKIPRO 2001 project “Empirical and Experimental Determination of Ship Resistance”. The current version runs under Windows NT/2000. The customers receive a database containing their own model test results from MARINTEK. Import and export functions makes it easy to add new results from model tests at MARINTEK.

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

1. Direct input of residual resistance and propulsive coefficients from model tests or calculations.
2. Residual resistance and propulsive coefficients derived from a search in the integrated database
3. Residual resistance derived from a comparison ship, where the influence on $C_R$ on the difference between the actual ship and the reference ship is calculated using one of the three empirical methods described below.
4. Holtrop 84 method.
5. Model resistance based on Hollenbach 98
6. Resistance regression derived from MARINTEK database using Artificial Neural Network.

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 program basically consists of three separate sub-programs or tools, which can be applied separately or together to obtain the information you need (see Figure 1).

Figure 1 EmPower program structure

First of all, 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.

Figure 2 Results database and filter criteria dialog

Figure 3 The curve fitting toolbox
In addition to the database, there is also a performance prediction tool that can be applied to carry out performance predictions based on Holtrup’s method, the Hollenbach 98 method, an Artificial Neural Network regression based on the MARINTEK 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.

Figure 4 Performance prediction in EmPower

The third component that is included in EmPower, is a propeller optimisation wizard, where the propeller diameter and/or pitch ratio can be optimised 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.

Figure 5 Propeller optimisation

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

Empirical Power prediction program for High Speed Ships

EmPower HS is a Windows based program designed to predict resistance and performance for high speed ships. EmPower HS is integrated in the same user interface as EmPower for conventional ships, but the calculations are performed independently, and versions with only EmPower HS are available.

The program is developed in MARINTEKs “Kystfart” and SKIPRO 2001 Research & Development projects. The current version runs under Windows NT/2000.

The following calculation methods are available for resistance and propulsion data:
1. CatRES regression analysis (High-speed displacement catamarans).
2. Savitsky’s method (Planing vessels).
4. NPL series (Round-bilge monohulls).
5. Fung-Leibman method monohulls (Round-bilge war-ship type monohulls).
7. VTT method for hard chime and bilge monohulls

Ship speed can be predicted by applying the empirical resistance prediction together with propulsor performance data. EmPower HS has four methods for specification of propulsor performance:
1. Gawn-Burrill KCA
2. Waterjet series (currently two different series)
3. User input thrust curve (typically information from a waterjet supplier)
4. User input open water curve

Figure 6 Deciding which method to use