During the last few years MARINTEK has developed a program for numerical calculation of wave resistance of ships, called Waveres. Waveres is integrated with the hydrodynamic workbench ShipX. The development has been a part of the strategic research programme SKIPRO 2001.

The motivation for developing a new numerical code to predict wave resistance of conventional ships is that current numerical codes often do not predict the wave resistance satisfactorily. In addition, current programs are usually very complicated to use, requiring that users have taken special courses. Also, setting up the analysis might take several days, with the need to transfer hull geometry between different formats and manually define the panels needed for the computations. In the development of Waveres, reliable prediction of the wave resistance and a quick, easy-to-learn user interface have been the main focus.

Waveres is integrated as an application in ShipX, and has the same intuitive, easy-to-use user interface as the rest of ShipX. When the ship hull lines have been imported in ShipX, the hull elements can be generated in a few minutes. Running the calculations takes from 15 minutes to several hours, depending on the speed of the computer, the number of velocities and the number of panels used. As soon as the calculations are finished, reports are available directly from ShipX. Visualisation of pressure and wave fields is done using GLView.
Numerical Method

Waveres applies potential flow theory to calculate the wave resistance. Calculation of total resistance in Waveres is based on the computed wave resistance and empirical formulas for the viscous resistance components. For the wave resistance problem it is believed that the strong non-linear effects are only located in the bow region. Thus, Waveres uses a conventional linear panel method for the entire ship, together with a non-linear correction computed only in the bow region. This novel non-linear method uses two-dimensional Laplace equation and three-dimensional free-surface conditions.

Verifications and Validation

The numerical program of the linear 3D solution has been verified by comparing with analytical and semi-analytical solutions. The first case is the flow past a sphere in infinite fluid. Both the velocity potential and the velocity on the body surface are checked. Satisfactory agreement is obtained. The second case is to test the numerical solution against the Green’s function (source) with forward speed. Good agreement is obtained. The method has been verified by thin ship theory for the wave resistance of the Wigley hull. Good agreement between the numerical and analytical solutions is obtained.

The theory has been validated by model tests for a number of passenger ships and car ferries, which have been carried out at MARINTEK.

Figure 1 Verification tests of reefer ship with and without bulb

Figure 2 Calculation of RoRo ships with different midship section coefficients

Figure 3 GLview visualisation of hull pressure and free surface wave field on a fast RoPax vessel at 25 knots