

ShipX Vessel Responses

A Vessel Responses Prediction Program For The Early Design Stage

SINTEF Ocean offers numerical calculations of ship motions as an alternative to, or in addition to model tests. The Veres (Vessel Response) program offers the ability to calculate ship motions and global loads, including the calculation of short term statistics, long term statistics and operability. The program is integrated in the hydrodynamic workbench ShipX.

The study of wave induced vessel responses is essential in the design of new ships. To optimize the operability of the vessel in a seaway, it is important to minimize the motions of the ship. If the loads are decreased, the steel weight can be reduced. Further, hydrodynamic loads and motions are important from the standpoint of safety of the ship and its crew. Veres is a tool which can be used in early design, in defining and evaluating model tests and in obtaining supplementary results. The program calculates:

- Motion transfer functions in six degrees of freedom
- Relative motion transfer functions
- Motion transfer functions at specified points
- Unsteady global loads
- Short term statistics of the above mentioned
- Long term statistics of the above mentioned
- Operability limiting boundaries
- Percentage operability

In this context, motions include displacements, velocities and accelerations.

Calculations can be performed for monohulls and multi-hulls at low as well as high speed. At low and moderate speeds, the traditional strip theory, developed by Salvesen, Tuck & Faltinsen is applied. At higher speeds, the high speed formulation developed by Faltinsen & Zhao is applied.

ROLL DAMPING

The program can include viscous roll damping from hull friction and bilge keels, as well as the effects of roll stabilizing tanks and active roll stabilizing fins.

MOTION CONTROL

The program can include the effects from passive free-surface roll stabilizing tanks, as well as active and passive U-tube tanks, rudder control and active and passive fins such as roll stabilizing fins and T-foils. The program can also include the effects from air cushions on Surface Effect Ships.

SHORT TERM STATISTICS

Short term statistics of the data from the calculations includes

- Standard deviations
- Significant values
- Expected maximum in a seastate of a given duration (e.g. 3 hours)
- Average of the 1/nth largest values
- Response zero-upcrossing period
- Plotting of response spectra

The calculations are based on selected standard wave spectra (P-M and JONSWAP), as well as measured wave spectra, and can be performed for long- and short-crested seas.

LONG TERM STATISTICS

Long term statistics of the data from the calculations can be calculated based on a specified scatter diagram.

The long term statistics can be calculated for each wave heading separately, or with a specified probability of each wave heading. A speed curve specifying the vessel speed as function of significant wave height can also be specified.

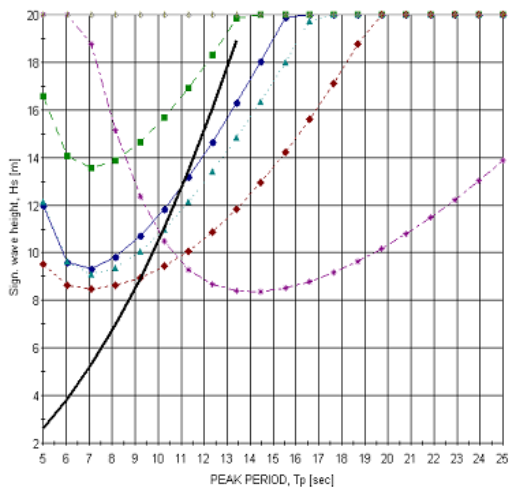
OPERABILITY

The calculation of operability is available in three modes:

1. Operability limiting boundaries presented as limiting significant wave heights as a function of the wave period
2. Operability diagram
3. Percentage operability

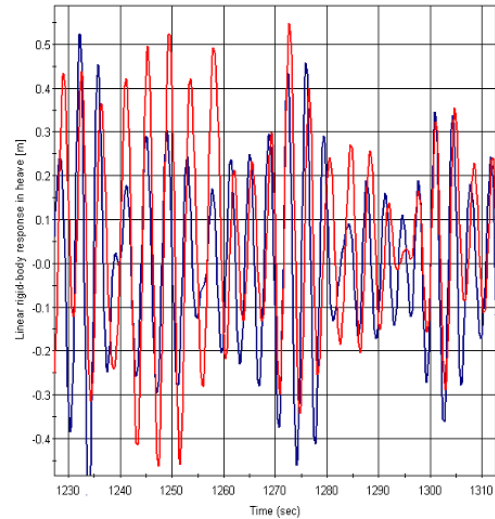
The operability can be calculated based on the following criteria:

- Motions in six degrees of freedom
- Relative vertical motions
- Probability of slamming
- Probability of green water on deck
- Probability of air exposure
- Vertical accelerations according to ISO 2631 (motion sickness)
- Motion-Induced Interruptions (MIIs)
- Motion Sickness Incidence (MSI)



TIME-DOMAIN CALCULATIONS

The ability to perform time-domain calculations is also available in Veres. In the time-domain calculations, the linear hydrodynamic coefficients of the ship hull can be combined with non-linear wave excitation forces and restoring forces, as well as non-linear effects from motion control systems.



— Linear rigid-body response in heave, RMS = 2.19010E-01 [m]
— Total rigid-body response in heave, RMS = 2.24765E-01 [m]