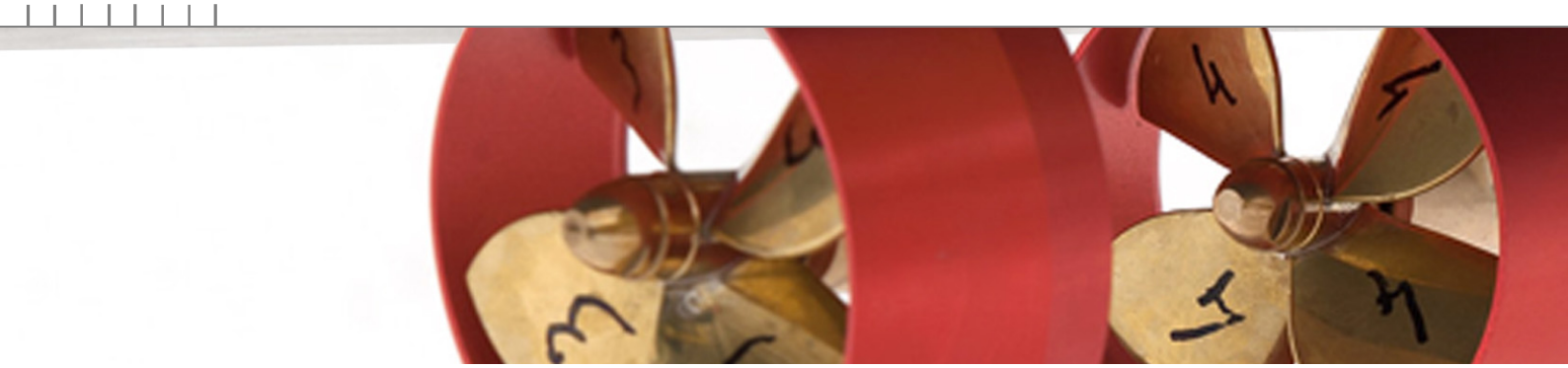
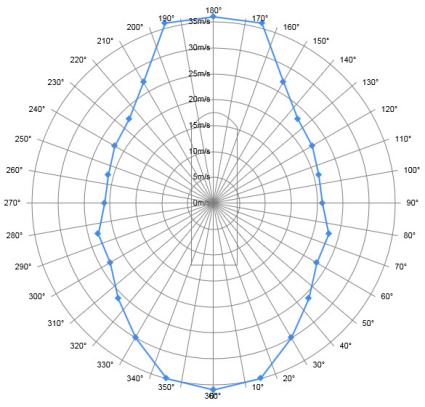


TRUST

The software TRUST can be used to perform static DP capability calculations. With TRUST different thruster configurations can be compared quickly, making it easy to optimise the vessel lay-out. The mean wind, wave and current loads acting on the vessel are calculated, after which the vessel thrusters are used to counteract the environmental loads. Thruster interaction losses can be taken into account to calculate a realistic stationkeeping capability.
Static calculations are most suitable in the early design stage, when the thruster lay-out is determined. The effect of the thruster configuration (thruster type, position and capacity) on the stationkeeping capability can be investigated efficiently. The calculation results do not include information in stationkeeping accuracy. The calculation results are presented in DP capability plots, showing the maximum wind speed at which the vessel can maintain its position.



Example DP Capability Plot

User interface

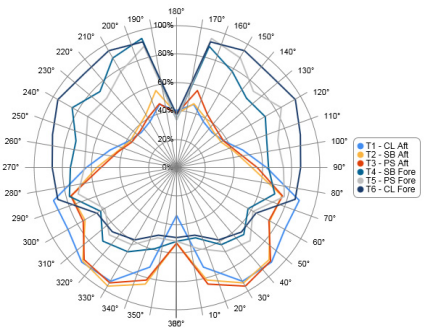
The program user interface was developed in QUAESTOR [1], a knowledge base system, developed at MARIN. The user interface has three main objectives. First, it offers a graphical presentation of the calculation input and output. The user can efficiently check the input (thruster position, wind and current coefficients, etc.) and review the calculation results (capability plots, thruster utilisation plots). Second, it checks the completeness and consistency of the input, using colours to indicate any missing or incorrect input data. Third, it generates an intermediate input file (*.XMF) and starts the program's calculation core.

Computational approach

The calculation core of the program is based on components from the XMF library, which contains calculation models that are also used in many other MARIN software applications. The XMF library is continuously maintained, expanded and further developed.

Wind and current forces

The mean wind and current loads are calculated using dimensionless load coefficients, defined according to the OCIMF convention [2]. The wind load coefficients, e.g. from wind tunnel measurements, are read from an ASCII format input file.



Example Thruster Utilization Plot

References:

- QUAESTOR, software information leaflet
- Oil Companies International Marine Forum (OCIMF), "Prediction of Wind and Current Loads on VLCCs", 2nd edition, 1994
- DIFFRAC / DRIFTP, software information leaflets
- "The Wake Flow behind Azimuthing Thrusters - Measurements in Open Water, Under a Plate and Under a Barge", Cozijn, J.L. and Hallmann, R. (MARIN), OMAE2012-83621, OMAE Conference, Rio de Janeiro, 2012

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Wave drift forces

The mean wave loads are calculated based on quadratic transfer functions (QTFs) for the mean wave drift forces. The QTFs are read from a hydrodynamic data base file (HYD-file), which is output from a linear diffraction calculation (DIFFRAC / DRIFTP). As an alternative, the QTFs can also be read from an ASCII format table file, making it easy to use QTF data from other sources.

Thruster forces

The mean thruster forces are calculated using 4Q propeller diagrams. Propeller diagrams from MARIN's B-series and Ka-series are included in the program data base. The current velocity and wake velocities of nearby thrusters are included in the thrust and torque calculation.

Thruster Interaction Effects

Thruster-hull, thruster-thruster and thruster-current interaction effects can be included in the calculations. Thruster-hull interaction effects are modelled using thruster-hull interaction coefficients, which are read from an ASCII input file. These coefficients can be determined by model experiments, CFD calculations or from data published in literature. Thruster-thruster and thruster-current interaction effects are taken into account by including the current velocity and the wake velocities of nearby thrusters in the propeller inflow.

Static equilibrium of forces

The required thrust is equal to the total mean wind, wave and current loads. A thrust allocation algorithm is used to distribute the total horizontal loads over the available thrusters, minimising the required power. The static equilibrium is found using an iterative solver.

Calculation types

The equilibrium of forces is calculated for a set of different wind, wave and current conditions. The following calculation types can be selected:

- ***Wind-wave relation***
  For each direction a range of wind velocities is considered. The associated wave conditions are taken from a wind-wave relation table (e.g. IMCA, or ERN). The current velocity is constant. The resulting DP capability plot shows the maximum wind velocity at which the vessel can maintain its position.

- ***Constant environment***
  Fixed wind, wave and current conditions are defined. For each direction the thruster loads are calculated. The resulting thruster utilisation plot shows the relative loading of the individual thrusters for each vessel heading.