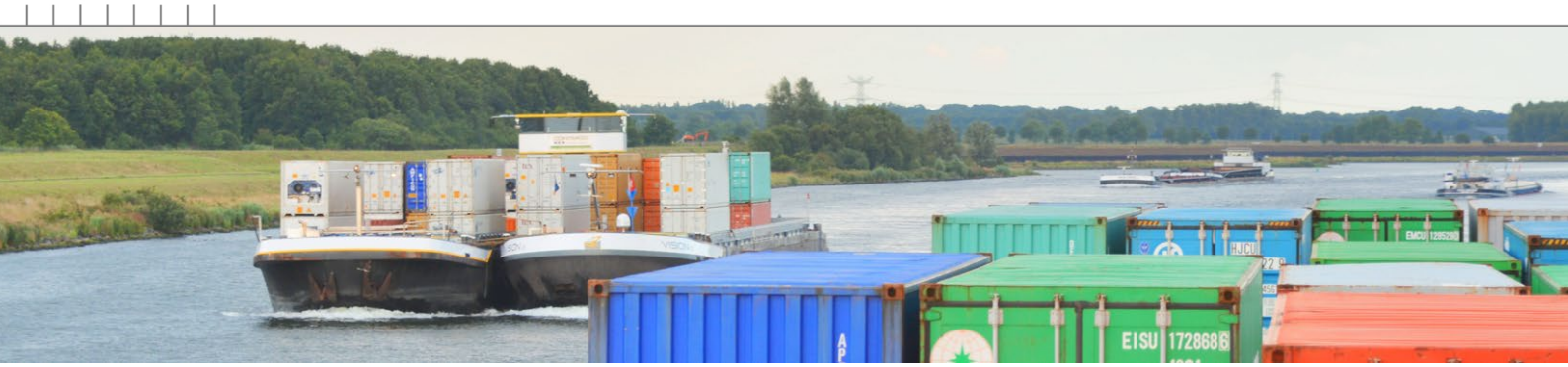
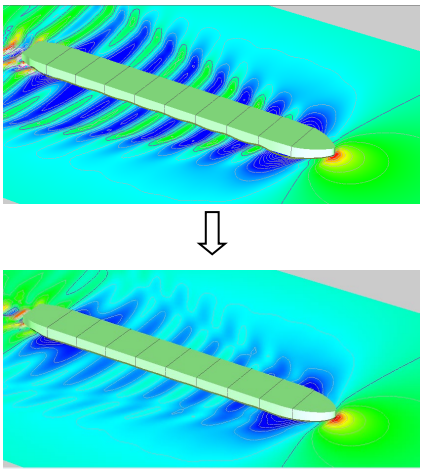


Improving inland ship design

Less resistance, more mileage

Increasing the energy efficiency of an inland ship can be done by improving the hull form or the propeller design. MARIN can assist in designing a new ship or optimising an existing lines plan or design. We start with an open discussion to investigate possible improvements and assess their feasibility: do the gains outweigh the costs? Next we choose the right tools to improve your inland ship design and to provide you, or the designer of your ship, with an optimised hull form or propeller design.

RAPID
RAPID is an CFD program (Computational Fluid Dynamics) that determines the friction-free (non-viscous) flow around the ship. The wave pattern is not affected significantly by viscosity, therefore RAPID can predict the wave pattern and estimate wave resistance. Since the bow generates most of the wave resistance, RAPID can be used to optimise the bow.



Statistical tools

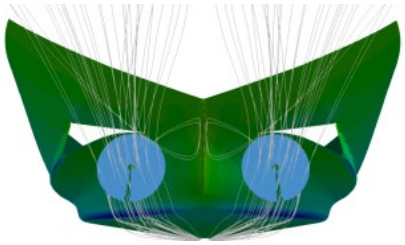
Most projects start with the application of statistics. For this, we use DESP. DESP estimates the propulsion power of a ship and compares it with similar ships that have been tested or designed at MARIN. DESP can thus be applied to determine the potential of optimisation. Moreover, the power estimate can be used to calculate fuel expenses and its potential reduction, as well as the pay-back time of the optimisation procedure. If the potential gains are promising and the benefits surpass the costs of the study, you can decide to start the project.

Bow shape optimisation

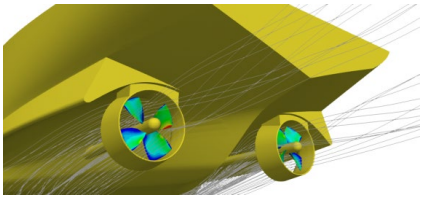
Reducing the resistance of the ship results in a lower power requirement. For inland ships, 5 to 15 percent of ship resistance is wave resistance, mainly produced by the bow. Subtle changes to the bow shape significantly reduce wave resistance.

To improve the bow shape, we use RAPID, a program that determines the wave pattern around the ship. One option is to adapt the shape based on results from an initial calculation. A more extensive approach is to generate multiple bow shapes and use optimisation software to pick out the bow shape that performs best. In case an operational profile is available, it is possible to optimise the bow for a situation that frequently occurs and has a strong impact on the ships operation, instead of optimising for a single situation. In this way, decent performance in multiple situations throughout the year can be obtained.

PARNASSOS
For the stern of the ship, viscous effects are important. This can be computed by using PARNASSOS. It requires limited computational power and can therefore be applied to analyse multiple stern shapes in order to select the best one. As PARNASSOS does not allow modelling appendages, it is especially suited for hull optimisation.



ReFRESCO
ReFRESCO is an advanced and flexible flow solver. It requires more computation time but allows adding appendages and rotation propellers, if needed. Therefore ReFRESCO can be used to optimise the duct and the propeller.



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Optimisation of the stern

For the stern, PARNASSOS or ReFRESCO is used. These programs, contrary to RAPID, include viscous effects (friction) that cannot be neglected in the flow around the stern. PARNASSOS is faster and more efficient, but limited in terms of hull form details that can be included. Its efficiency, however, allows for an extensive approach using multiple stern shapes and searching for the best stern design. ReFRESCO requires more computing power, but allows adding complex appendages such as propeller ducts, bow thrusters, struts, and rudders.

Model tests

While RAPID, PARNASSOS and ReFRESCO give very detailed information on the flow and show possibilities for improvements, most accurate estimate of the achievable speed (or the required propulsion power) is obtained by model testing. By scaling model test results to full-scale operational data, an accurate estimate can be made.

Options

Which tool you apply for the optimisation of your ship, depends upon many factors. Employing statistics to find possibilities for improvement can be easily done at low costs. Bow optimisation by performing RAPID calculations only takes a few hours. As for the stern, you can decide how much detail you want to include. Significant improvements can already be obtained by optimising the bare hull with PARNASSOS or (with a duct) ReFRESCO, without having to include all appendages in every calculation.

Your input is important too!

To get the best result, the input should be as detailed as the output will be. An inland ship encounters multiple water depths during its lifetime, hence it is valuable to choose the water depth (or multiple water depths) that occur(s) most frequently. The same accounts for speed and loading draft. Additionally, a good description of the freedom and fixed points for the hull shape ensures that there is no need to re-adjust the hull form after the optimisation procedure has finished.

Feel free to contact us!

Altogether, MARIN offers a range of tools to improve your ship's fuel efficiency. Which of the tools we apply is depending on what you need and what you expect. Interested? Contact us to discuss - free of charge - the possibilities for increasing the energy efficiency of your ship.