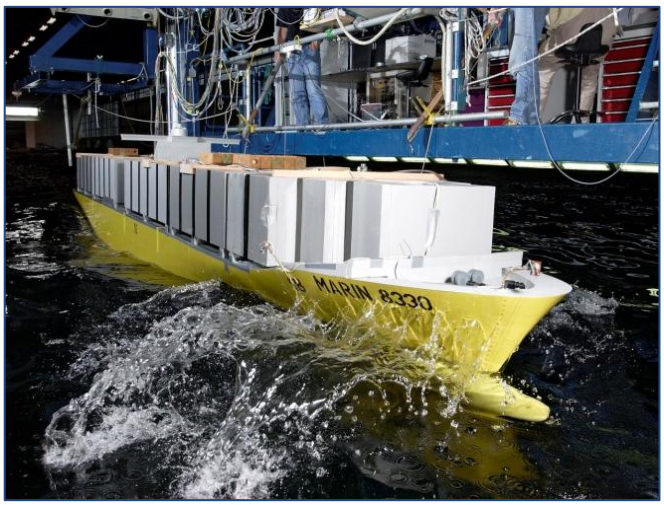
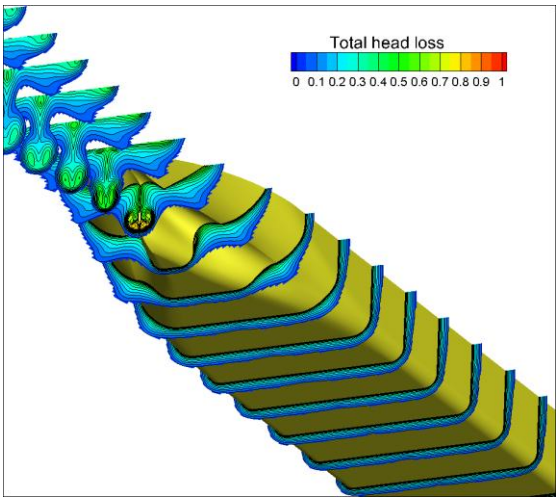
M.Sc.-thesis research

Efficiency improvement of a viscous flow solver used for optimization of ships and propellers

Company profile MARIN, located in Wageningen, has been expanding the boundaries of maritime understanding with hydrodynamic research for over 85 years. Today, this research is applied for the benefit of Concept Development, Design Support, Operations Support and Tool Development. The services incorporate a unique combination of simulation, model testing, full-scale measurements and training programs.





Project Background Reducing fuel consumption of a ship can be done by improving the hull form design and/or by increasing the efficiency of its propeller. Computational Fluid Dynamics (CFD) plays an ever-increasing role to achieve this, as it permits extensive design studies prior to any model testing. Instead of using one CFD-computation, automatic optimization procedures can be used to evaluate a series of hull forms and propellers.

Automatic optimization of ships or propellers with hundreds or thousands of calculations is often impractically time-consuming. Most of the CPU-time is spent in the solution of large systems of linear equations, in which the coefficient matrix is sparse.
The current technique to solve these systems is by using an iterative method (GMRES) combined with an incomplete LU-decomposition as preconditioner. Improving the (parallel) performance of this linear solver, by using block-Jacobi type preconditioning techniques, will be the main topic of research in this graduation project. In such a block-Jacobi type preconditioner, the incomplete LU-decomposition is combined with direct solution of smaller sub-systems associated with sub-blocks on the main diagonal. In recent years, strong progress in the efficiency of direct solution methods of such sub-systems has been reported in literature.

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