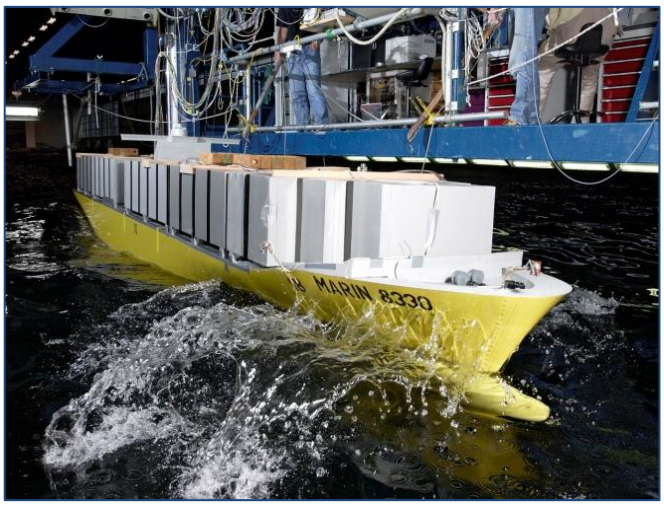
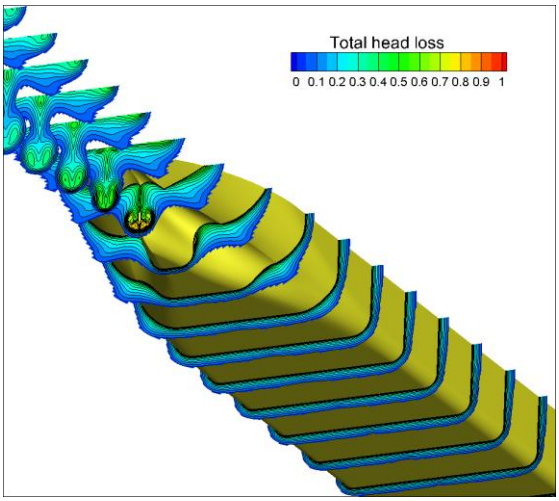
M.Sc.-thesis research

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

Company profile MARIN, located in Wageningen, has been expanding the boundaries of maritime understanding with hydrodynamic research for over 80 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 One of the most effective ways to reduce fuel consumption of a ship is to improve the hull form design. 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.

For the optimization of the aft part of a ship, viscous effects cannot be discarded. This strongly increases the required computational effort. At MARIN, the viscous flow solver PARNASSOS has been developed. This code is fast and uses only limited memory and is therefore well suited to use as evaluation tool within an optimization process. However, one hull form evaluation can still take hours or even days. Therefore, automatic optimization with hundreds or thousands of calculations is impractically time-consuming. Most of the CPU-time is spent in the solution of large systems of linear equations $Ax=b$, in which the coefficient matrix is sparse.

The current technique to solve the systems $Ax=b$ is by using an iterative method (GMRES) combined with an incomplete LU-decomposition as preconditioner. Improving the performance of this linear solver, by using the Graphical Processing Unit (GPU) will be the main topic of research in this graduation project.

Contact For more information contact Dr. Ir. Auke van der Ploeg (a.v.d.ploeg@marin.nl, 0317-493320).