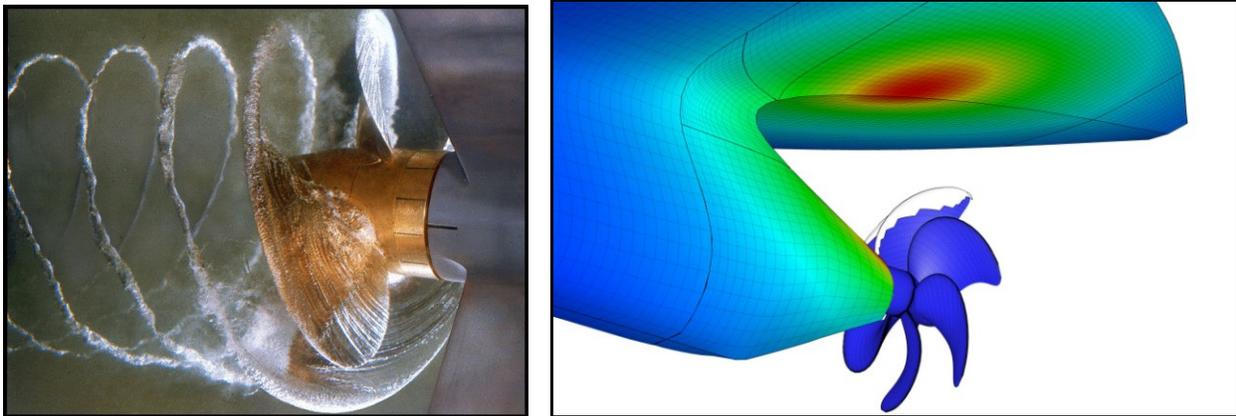


## Efficiency improvement of panel codes for the maritime industry

**Company profile** MARIN, located in Wageningen, has been expanding the boundaries of maritime understanding with hydrodynamic research for over 75 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** At MARIN several Boundary Element Methods (panel codes) are used to compute the flow around ships and propellers. Examples of such panel codes are RAPID which computes the wave system generated by the ship, PROCAL which is used for the analysis of propellers and EXCALIBUR which computes the hull pressure fluctuations induced by the propeller. Currently, in practical ship design projects, these panel codes are ran on PCs. In these codes large systems of linear equations ( $Ax=b$ ) have to be solved in which the matrix  $A$  is not sparse. Currently, the number of panels, and thereby the size of  $A$ , is limited by the amount of available computer memory. When those panel codes are combined with methods for automatic optimization a large number of hull forms and/or propeller geometries have to be evaluated and in that case it is very important to reduce the required computation time.

**Tasks** 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 will be the main topic of research in this graduation project. The following possibilities to reduce the computational time can be investigated

- Use of the Graphical Processing Unit.
- Parallelization using open MP, which is expected to significantly reduce the computational time on modern PCs which contain several processors.
- Parallelization on distributed memory systems using MPI. This also has the advantage that a larger number of panels can be used, which for some problems significantly increases the accuracy of the computed results.

**Contact** For more information contact Dr. Ir. Auke van der Ploeg ([a.v.d.ploeg@marin.nl](mailto:a.v.d.ploeg@marin.nl), 0317-493320), or Ir. Erik van Wijngaarden ([H.C.J.v.Wijngaarden@marin.nl](mailto:H.C.J.v.Wijngaarden@marin.nl), 0317-493439).