M.Sc.-thesis research

Interactive waves for real-time ship simulation

in collaboration with MARIN

Background

MARIN (Maritime Research Institute Netherlands) provides ship manoeuvring simulators that offer a variety of maritime operations for virtually every type of ship and propulsion. The current computational model for the wave field is based on wave spectra, that are converted to time signals through Fourier transformation. This has the benefit of being deterministic in time and location and therefore is easy to implement on our distributed simulation systems. However, this model is not interactive, that is diffraction, reflection, refraction and depth dependency are not taken into account. From a visualization point of view, the model is limited too. However, better visualization models (used in movies like Waterworld, Titanic, Perfect Storm) lack physical realism.

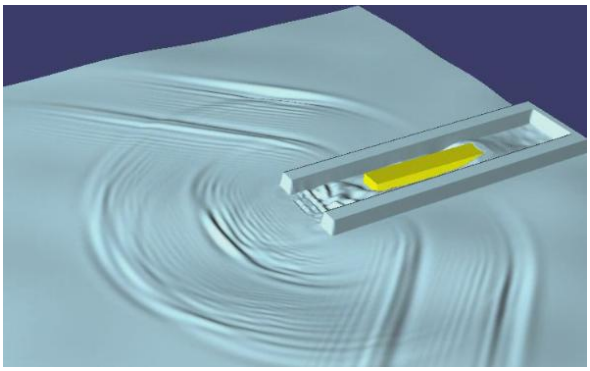
Some images of the current ship simulator. The waves do not yet interact with ships and their environment.

MARIN wishes to use the so-called Variational Boussinesq Model to compute and visualize the wave field. This physically realistic model does provide interaction with objects, diffraction, reflection etc.

Two previous MSc Thesis projects (by Elwin van 't Wout and Martijn de Jong) have brought us to the point where it is possible to calculate real time the wave field using a uniform mesh consisting of 1,000,000 cells of constant size. For 5m cells, this results in a total simulated area of 5 x 5 km. To be useful in our manoeuvring simulator, a finer grid and/or larger domain are required and this still needs to be computed in real time. The current code uses parallel computations on the GPU.

Required research

Recently, a preliminary study has been carried out on the behaviour of landing crafts returning back to the dock landing ship. In these cases smaller grid sizes are required and this puts severe restrictions on the time step. As a solution to this problem the possibility to a) use non-uniform meshes and b) modify the time-integration procedure (now explicit) are considered. However, both these approaches need further research and implementation. This subject is particularly fit for a student who enjoys (advanced) programming. The programming language used is C++.



Typical interactive wave application (landing vessels)

Location

The work will be done at MARIN in Wageningen. MARIN has been an independent and innovative service provider for the maritime sector worldwide for more than 75 years now. The research is carried out by model tests in large basins and by advanced computer simulations. In its field MARIN is one of the leading institutions in the world. Wageningen is a small but pleasant student city.