

*photos: courtesy of Marin*

## Industrial Automation and Machinery

# Predictive Modeling of a Carriage

## Maritime Research Institute Netherlands

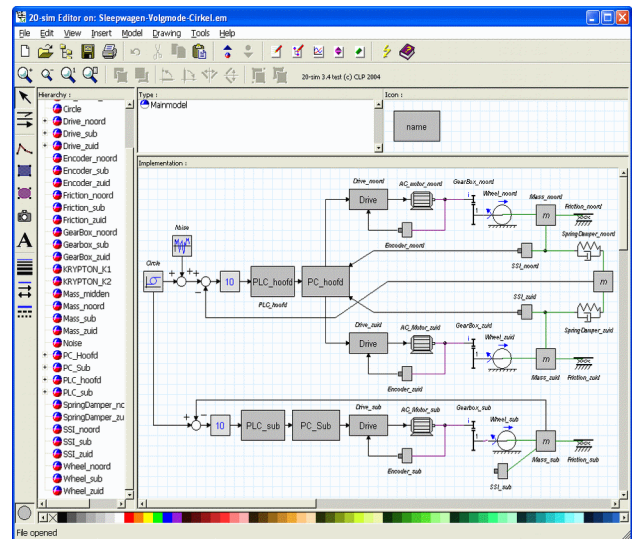
The Maritime Research Institute Netherlands (MARIN) was founded in 1929 by the Dutch government and industry with the aim to improve ship design by the study of ship models. To cope with the industry demand for research in the fields of sea keeping and manoeuvring, gravitation, vibration, and noise, a whole series of special test laboratories was successively built: Deep Water Towing Tank 1951, Shallow Water Basin 1958, High Speed Basin 1965, Depressurized Towing Tank 1972 and Gravitation tunnel 1979. A new Sea keeping and Manoeuvring Basin became operational in the course of 1999.

The Sea keeping and Manoeuvring Basin has been built with special equipment to generate waves in an arbitrary direction. To keep track of the ship model and support its data cable coming from the ship model, a carriage was designed. The carriage runs over the total length of the basin. It consists of a mainframe, spanning the full width of the basin and a sub frame. The carriage can follow all movements of the model in the horizontal plane. On the sub frame of the carriage a platform is mounted with equipment for storage and analysis of the measurement data coming from the ship model. The platform can carry up to 6 people to operate the carriage and measurement equipment.



The Sea keeping and Manoeuvring Basin.

During free running tests, a stereo vision camera on the platform continuously measures the position of the ship model. A feedback loop consisting of a 40 Hz PLC, a 100 Hz PC and motor controllers is used to convert the position of the ship model into the proper carriage movement. As a result the carriage will closely follow the moving ship model and prevent its data cable from dragging and thus disturbing the measurements.



The carriage model in 20-sim.

Controllab Products B.V. has been commissioned to design a controller for the feedback loop that will provide good tracking performance for the carriage in all wave conditions. The whole carriage including feedback loop was identified by various measurements and analysis. A model was created and implemented in 20-sim to predict the behavior of the carriage as a function of the moving ship. Analysis of the resulting simulations in 20-sim, led to the design of a distributed controller that would drive the carriage to smoothly follow a ship in calm water as well as large waves. The controller was implemented by Controllab Products B.V. Subsequent tests on the carriage confirmed the validity of the model and showed a considerable decrease of the tracking error for all wave conditions.

## Contact

info@20sim.com  
+31 (0)85 773 1872