

## Marine Cybernetics lab

The Marine Cybernetics Laboratory is a wave basin, suitable for specialized hydrodynamic tests. It has also an advanced towing carriage, which has capability for precise movement of models in six degrees of freedom.

Capacities:	Experimental set-ups:
<ul style="list-style-type: none"> <li>• Tank dimensions: L x B x D = 40m x 6.45m x 1.5m</li> <li>• Wave maker</li> <li>• Towing carriage: towing speed 2 m/s, 5 (6) DOFs forced motions</li> <li>• Computer system for control, data recording and analysis</li> <li>• Typical scaling ratios: <math>\lambda = 50-150</math></li> <li>• Typical model dimensions: 1-3m</li> <li>• Positioning system measure 6DOF in real-time</li> </ul>	<ul style="list-style-type: none"> <li>• DP and way-point tracking (wireless control) of ships and semi-submersibles</li> <li>• Testing of models of aquaculture plants exposed to waves and current</li> <li>• Crane operations</li> <li>• Propulsor and thruster control</li> <li>• Rapid control prototyping</li> <li>• Planar motion mechanism (PMM) and vertical motion mechanism (VMM) tests</li> <li>• Calibration of transducers</li> <li>• Hardware-In-the-Loop (HIL) experiment laboratory</li> </ul>

## Wave maker with AWACS

The wave maker is a 6m width single paddle and is operated with a electrical servo actuator. The system is equipped with an Active Wave Absorption Control System (AWACS 2) and a DHI Wave Synthesizer which can produce regular and irregular waves.

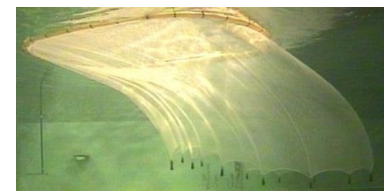
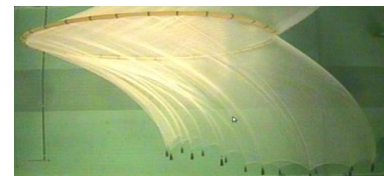
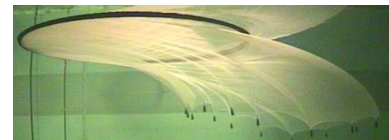
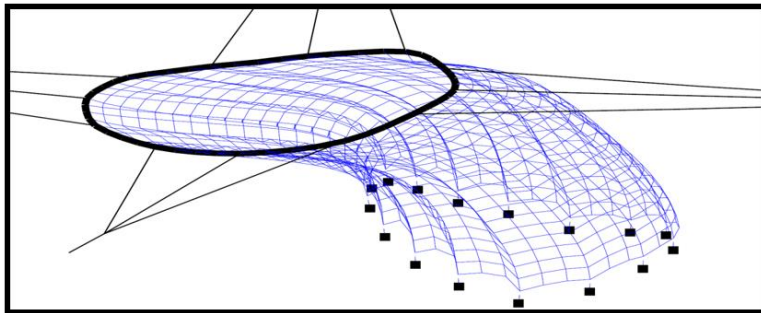
- Regular waves  $H < 0.25$ ,  $T = 0.3 - 3$  s.
- Irregular waves  $H_s < 0.15$  m,  $T = 0.6 - 1.5$  s.
- Available Spectrums: JONSWAP, Pierson-Moskowitz, Bretschneider, ISSC, ITTC, ...
- Wave controller update rate = 10 Hz
- No. wave gauges on paddle = 4
- Stroke length on actuator = 590 mm.
- Actuator speed limit = 1.2 m/s.

### Using the Marine Cybernetics lab for aquaculture-related research

With the capability to model the marine environment in terms of waves and current, the Marine Cybernetics laboratory has been found to be very useful for scale-model testing of the behavior of fish net cages and similar structures in waves and current. Typically, the laboratory is used to explore physical phenomena as a foundation for development of theoretical and numerical calculation models, and to validate the same, as indicated by the pictures below. Current is modelled by towing the structure using the towing carriage. A water circulation system to create current is under installation and might be available to AquaExcel users. The basin contains fresh water, filled from the public water supply system. Tests are normally performed without any living organism being part of the test, but as shown in the pictures below, tests have also been performed with live fish.

A list of references to scientific work of this type, using the Marine Cybernetics lab, is given below the pictures.

### Linking theory to experiments



### Experiments with fish



### References

Kristiansen, T. and Faltinsen, O. 2015. Experimental and numerical study of an aquaculture net cage with floater in waves and current. *Journal of Fluids and Structures* 54 (2015) 1–26

Kristiansen, T., Faltinsen, O. F. 2012. Modelling of current loads on aquaculture net cages. *Journal of Fluids and Structures* 34 (2012) 218–235

Li, P., Faltinsen, O.M., Lugni, C. Nonlinear vertical accelerations of a floating torus in regular waves. Submitted to *Journal of Fluids and Structures*.