Offshore Fish Farm

Norwegian aquaculture industry has witnessed a tremendous development through recent years. Salmon sales in 2017 reached 1.2 million tonnes with first-hand value over 7.6 billion USD. It is expected that the annual salmon sales will reach 5 million tonnes by 2050 provided key production and environmental challenges are met. Up to year 2017, there are 1130 licenses for food production of salmon and rainbow trout along Norwegian coastlines. A modern fish farm contains up to 16 cages and 200,000 salmon fish.
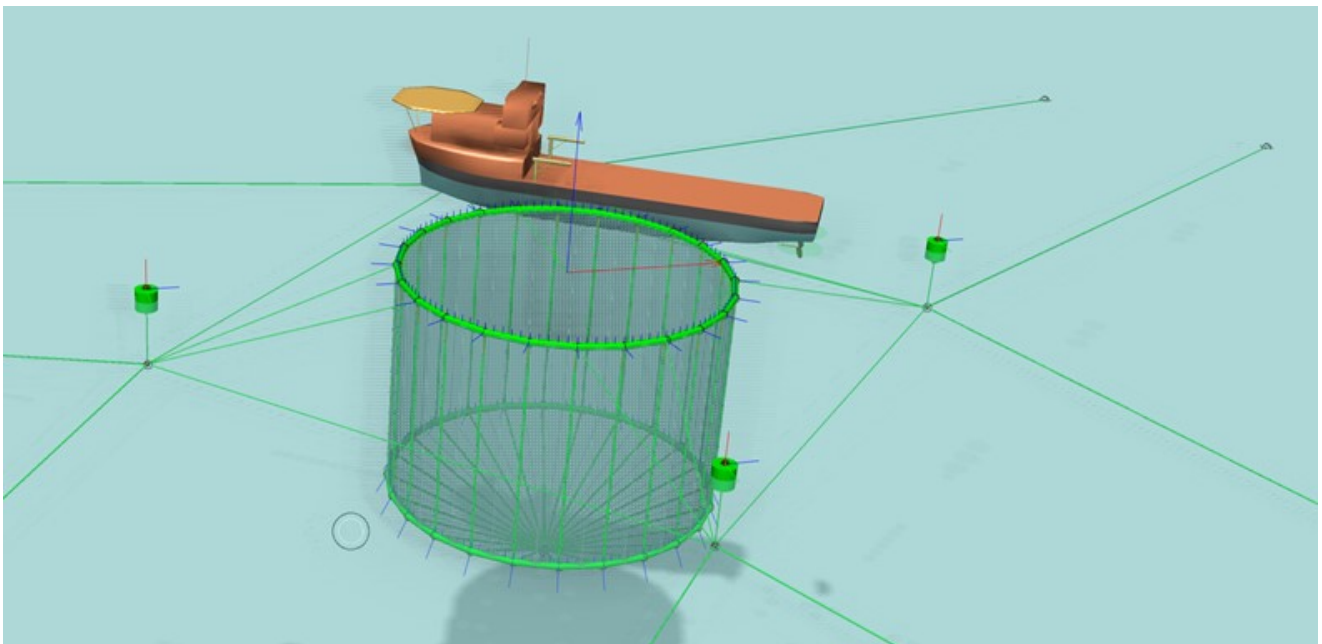

Figure 2: cage-vessel coupled system modelled in SIMO-RIFLEX/SIMA

DEVELOPING FUTURE AQUACULTURE

Aquaculture is mostly an experience-based industry with fish farms established at areas close to shore due to the advantage of easy access/operation under benign weather condition. The operations are used to be performed based on farmers' experience. However, due to limited coastal areas, most aquaculture activities may need to be performed at more exposed offshore sites in future.

Severe weather condition at the exposed site brings challenges in the design, operation and maintenance of the future offshore fish farms.

Prediction of key parameters of an operation under foreseen weather conditions and online monitoring of undergoing operation becomes important when aquaculture facilities are moved to offshore locations.

To facilitate the further development of aquaculture industry, SINTEF Ocean contributes in the following areas.

EXPERIMENTAL INVESTIGATION EXAMPLES

- Towing tests of net element to study hydrodynamic loads onto net structure for new net design

- Testing single fish cage/fish farm's response in wind, wave and current, together with mooring system to find cage motion response and deformation, stress in floating/bottom collar and mooring line tension

- Testing coupled cage – vessel system in wind, wave and current with mooring and DP system to find hydrodynamic interaction effect between vessel and cage, tension in connection lines in addition to cage and vessel motion and cage deformation

NUMERICAL INVESTIGATION EXAMPLES

- Numerical modelling of gravity type of fish cage and mooring system with RIFLEX/SIMA

- Numerical modelling of rigid type fish cage with mooring system with SIMO/SIMA, like Ocean Farm 1

- Numerical modelling of fish cage/farm - vessel coupled system with coupled SIMO-RIFLEX model. DP system on board vessel can be modelled in SIMO.

ONLINE TOOLS DEVELOPMENT EXAMPLES

- Online monitoring of cage response / deformation in a sea environment

- Online monitoring of mooring line tension

- Online monitoring of vessel – cage operations by providing information for coupled vessel and cage responses, force in connection lines between vessel and cage

- Operation window prediction by estimating key operation parameters in different sea conditions and giving operation limit for particular operations

A comparison of measured and calculated cage response is illustrated in Figure 1. The numerical model of the gravity fish cage is established in RIFLEX. A cage – vessel coupled system modelled using SIMO-RIFLEX is illustrated in Figure 2.
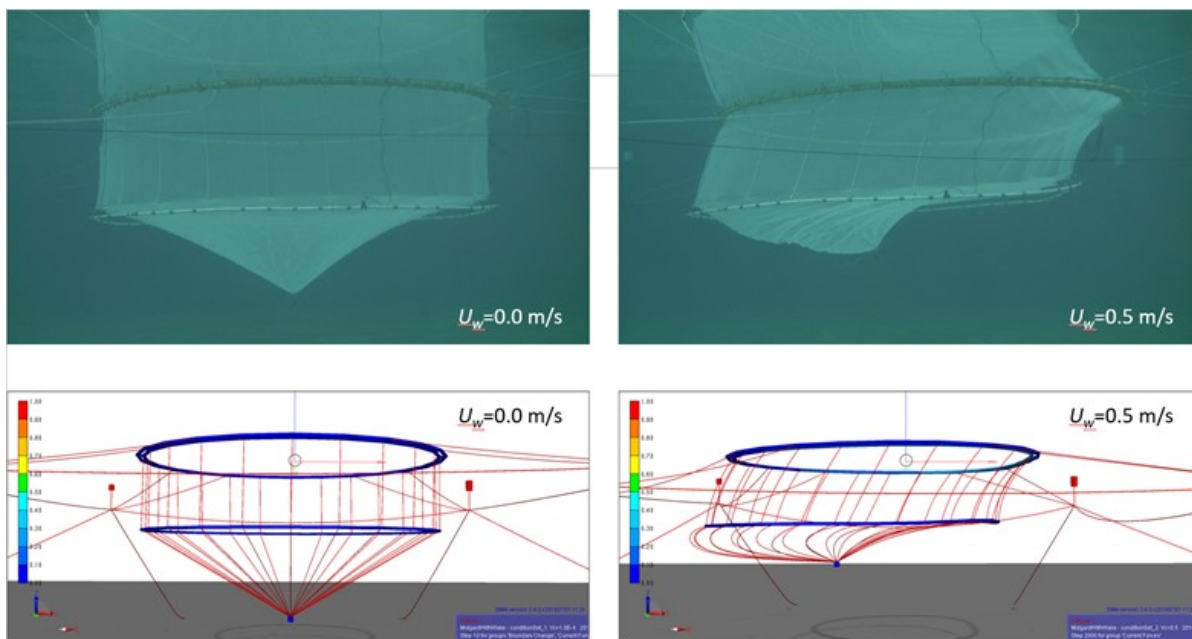

Figure 2: cage-vessel coupled system modelled in SIMO-RIFLEX/SIMA

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TECHNOLOGY FOR A BETTER SOCIETY