# Application of FhSim for the Analysis of Environmental Loads on a Complete Fish-Farm System

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## ABSTRACT

Fish farming at exposed locations requires robust and reliable structures that facilitate sustainable, safe and efficient production. There is also a need for proper numerical tools and analysis methods that can be utilised for designing such structures and evaluating their performance under increased exposure. Some recent advances in developing and applying such tools are highlighted in the present paper. An analysis of the mooring loads of a complete multi-cage fish farm exposed to currents and waves is presented. This analysis is based on numerical simulations performed with FhSim, which is a software framework developed at SINTEF Ocean for simulating marine systems and flexible net structures in the time domain. Previously, FhSim has been used to simulate loads on a single net cage, and the results have shown a good agreement with experimental data [1]. In the present work, a numerical model of a conventional fish farm with multiple interconnected net cages was built, and the effects of environmental conditions on the mooring loads and their distribution in the mooring system were investigated. Additionally, the sensitivity of the mooring loads to various parameters of the model were studied.

The results have shown that for fish farms operating in marine areas with high current velocities (over 0.5 m/s) under typical wave conditions, the mooring loads are dominated by the current-induced forces rather than the wave forces. Consequently, the assumptions and uncertainties associated with the model for viscous drag on the flexible net structure have the strongest effect on the mooring forces and thus the results of this analysis. Other considered uncertainties associated with the structural parameters of the model did not show such a strong effect on the predicted results. Thus, to significantly improve the present model, more research should be done to refine the load model for net structures.

## REFERENCES

[1] Endresen, P. C., Birkevold, J., Føre, M., Fredheim, A., Kristiansen, D., and Lader, P., "Simulation and validation of a numerical model of a full aquaculture net-cage system". *In Proceedings of OMAE 2014*.