Dynamic modelling of a floating offshore wind turbine with integrated fish cage

Available space to produce energy and food is becoming more and more scarce. Onshore and offshore civil projects are now obligated to optimise their footprints in order to satisfy planning constraints while remaining economically viable. In the development of floating offshore wind turbines (FOWT) projects, there is space available between turbines (suitable for floating solar for instance) and, in the case of some semi-submersible systems, there is available space within the floater itself. In this context, the EU funded AQUAWIND project aims to perform a demonstration test of a multi-use, integrated and co-located solution. The proposed platform consists of combining an innovative finfish aquaculture solution (currently at TRL4) within the semisubmersible floater of an existing FOWT prototype (W2Power) currently at TRL6. The project also aims at performing, for the first-time, test trials of live fish aquaculture in the Atlantic region (PLOCAN test site, Las Palmas de Gran Canaria port).

The aim of this study is to model the overall system hydrodynamic behaviour using the time-domain software OrcaFlex, developed by Orcina. The results of the study will be used to inform the integration (retrofit) of the fish cage with the FOWT before deployment at the PLOCAN test site.

The time-domain modelling of aquaculture nets is a relatively recent subject (2015) with roots in the modelling of trawling nets. The challenge relating to modelling aquaculture systems revolves largely around the approximation of the net hydrodynamics. The hydrodynamic response can be characterised knowing the material; geometrical parameters (including mesh shape, mesh size, twine diameter); and production methods i.e., twine weaving method (twisted or braided) and net weaving method (knotless or knotted).

Two approaches are commonly proposed to model aquaculture nets: Morrison and Screen models. Both approaches will be compared in this study, with eventual favour found for the Morrison model due to its simple implementation in Orcaflex. This study will also consider wake effects within the net, and between the net and FOWT as this phenomenon can increase mooring forces. A sensitivity study will be performed in order to define the parameters of the Morrison model and wake effects in order to find a compromise between computation time and accuracy.