Msc Thesis

Title: **Aerodynamic Analysis of Floating Offshore Wind Turbines: Realistic Conditions**

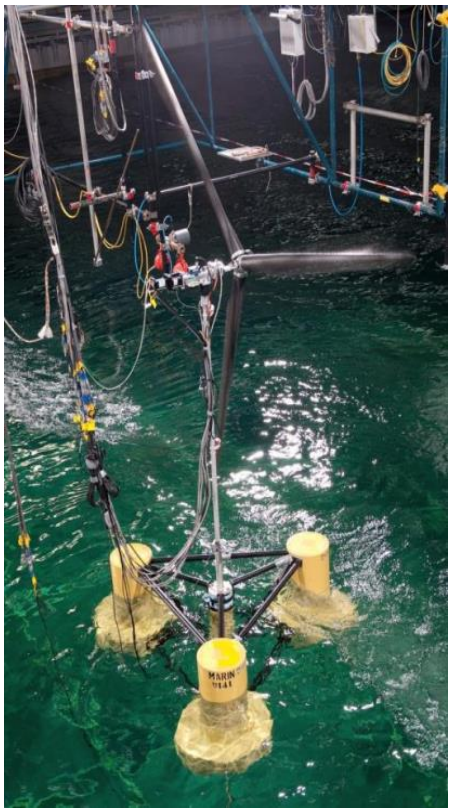
Requirements: Fluid Mechanics, Aerodynamics, Numerical Methods, Linux
Knowledge on CFD, grid generation, Paraview, Python, HPC is a pre

Duration: 6-9 months

Location: IST and WavEC-Offshore Renewables (www.wavec.org) (Lisbon, Portugal)

Supervisors: **Dr. João Baltazar (IST), Dr. Guilherme Vaz (WavEC)**

Description



Floating offshore wind turbines (FOWT) are taken up by the mainstream research community in recent years. Taking the advantages of more abundant wind energy far from shore, deploying wind turbines into deep water with a floating support structure would be the most economical solution at some sites. In Portugal, this October of 2019 the first WindFloat-Atlantic FOWT started to be installed. FOWT are exposed to the critical loading of wind, current and wave at far shore environment. The challenges of dangerous environmental loads and large motions of both rotor and platform potentially render current techniques applied for fixed-bottom offshore turbines insufficient for accurately describing the dynamics of floating ones. Also, fully description of the dynamics of FOWT can be decomposed into three parts: aerodynamics of wind turbines, hydrodynamics of the support platform and dynamics of the mooring system.

In this project, we propose to analyze the aerodynamic behavior of NREL 5MW turbine and/or Marin FOWT benchmark cases using high-fidelity CFD tools only. But not only undisturbed inflow conditions are to be simulated, but also the aerodynamic performance of the turbine blades under realistic unsteady turbulent flows, and under imposed motion typical from the hydrodynamic platform are to be considered. In particular, the objectives of this project consist in performing the following studies:

- Analysis of the turbine at full-scale conditions using RANS together with linear and non-linear turbulence models.
- Analysis of the turbine under unsteady turbulent inflows. Use of SRS (PANS/DDES/LES) methods.
- Analysis of the interaction of blades and turbine tower.
- Study of the flow around the blades and tower under imposed motion (typical) from the hydrodynamic platform.

All this involves thorough verification and validation against available experiments (if available from the OC6 NREL consortium). Studies on the influence of grids, time-steps, numerical schemes and other CFD-relevant issues will be also performed. For this work, the candidate will have access to Portuguese and European HPC super-computers. Upon good performance of the candidate the work may be presented in a conference and/or in a Journal.

Bibliography

1. Make, M. and Vaz, G., “Analysing Scale Effects on Offshore Wind Turbines using CFD”, In Journal of Renewable Energy, Volume 83 pages 1326-1340, November 2015 (http://doi.org/10.1016/j.renene.2015.05.048).
2. De Ridder, E.-J., Otto, W., Zondervan, G., Huijs F. and Vaz, G., “Development of a Scaled-Down Floating Wind Turbine for Offshore Basin Testing”, In Proceedings of OMAE2014, San Francisco, California, USA, June 2014.