Msc Thesis

Title: **Hydrodynamic Analysis of Floating Offshore Wind Turbines: Captive Structure**

Requirements: Fluid Mechanics, 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. While the first operational floating wind farm was commissioned at Scotland in 2017, 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. This makes the design and analysis of FOWTs a challenging engineering problem.

In this project, we propose to analyze the hydrodynamic behavior of NREL OC6 FOWT benchmark case only in captive conditions. In particular, the objectives are to perform the following studies using open-source multiphase viscous-flow CFD code ReFRESCO (www.refresco.org):

- Analysis of the platform under current/towing tests (different speeds).
- Analysis of the platform under imposed motion (different amplitudes and frequencies).
- Analysis of the wave impacts on the platform (different types of waves)

All this involves thorough verification and validation against available experiments (OC6 NREL consortium). Studies on the influence of grids, time-steps, turbulence models, 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. Wang, Y., Chen, H.C., Vaz, G. and Burmester, S., ”CFD Simulation of Semi-Submersible Floating Offshore Wind Turbine under Pitch Decay Motion”, in proceedings of 2nd International Offshore Wind Technical Conference, IOWTC2019, St. Julian’s, Malta November 2019.
2. Burmester, S., Vaz, G., Gueydon, S. and Moctar, B. O., “Investigation of a Semi-Submersible Floating Wind Turbine in Surge Decay using CFD”, in Ship Technology Research, December2018 (https://doi.org/10.1080/09377255.2018.1555987).
3. 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).
4. 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.