Scholarship Application Template

PhD SCHOLARSHIP APPLICATION DATA

Business Division Business Area	Energy and Environment Offshore Renewable Energy
Scholarship location Province/Building	Derio /Edificio 700

SCHOLARSHIP DESCRIPTION

Title: Control strategies to extend the useful life of offshore wind turbines on floating platforms.

Brief description of scholarship:

Wind power is a mature technology with a long history and in-depth research into control systems for the extraction of the maximum power. The same controls for onshore wind power can be applied to offshore wind power in order to maximise the power. However, in the case of floating wind turbines, additional loads arise which may cause damage due to fatigue and which affect the useful life of the components, reduce their life cycle and therefore affect the availability of energy and increase its cost.

The purpose of this thesis is to analyse how control can have a positive effect on the reduction of the damage caused by fatigue on the most critical points of the wind turbine, and design a strategy to maximise the energy extracted and reduce the movements of the structure and the dynamic loads that are generated therein. The main difficulty lies in finding the balance between energy production and structural loads.

The search for this balance is a feedback exercise, in which design options will be taken into account, giving rise to recommendations for manufactures of the different components of the wind turbine. .

Scholarship description:

The scholarship work falls within the floating platform strategy for offshore wind turbines in the **Offshore Renewable Energy** area of the Energy and Environment Division. This research line focuses essentially on the NAUTILUS platform (See: www.nautilusfs.com).

The following tasks will be undertaken throughout the scholarship:

T1 State of the art of control systems for floating wind power

The purpose of this first task is to understand the controls that have been developed to resolve the added control difficulties in floating wind power, through a review of the state of the art.

One of the critical points is the negative cushioning that occurs at wind speeds in excess of those corresponding to the nominal power, which introduces the control applied onshore and induces

wobbling in the platform. This aspect may produce fatigue in the components that form part of the nacelle and the structure.

T2 Development of a numeric model of floating wind turbine considering the interaction between the platform and the wind turbine itself

The purpose of this task is the development of a numeric model in which the hydrodynamic, aerodynamic, mooring and extraction system and energy transformation forces are represented, based on the experience acquired in the development of the NAUTILUS floating platform. With these models, the aim is to show as reliably as possible the dynamics of a floating wind turbine, as well as the influence of the applicable controls.

T3 Definition of the critical points: tower, blades, other components
A study will be carried out on the need to adapt the traditional wind power controllers fixed to the floating part, identifying the critical points likely to require improvements.

Structural elements, such as blades and the tower will be analysed, as well as elements belonging to the energy extraction system, such as the multiplier, generator or power electronics.

The purpose of this task is to identify the critical functioning point in the components whose life-cycle is affected by the fact of being in a floating structure.

T4 Design of control strategies optimising the different elements of the analysis: production, useful life, availability, structural loads, platform dynamics, metocean conditions, etc.

The influence of control in the critical points identified in the previous task will be analysed.

A control adapted to the case study of a semi-submersible platform is going to be designed and developed in order to extend the useful life of the critical components through the adaptation of the control to avoid excessive vibrations, overloads and oscillations that lead to a malfunctioning of the whole system, reducing the efficiency and life cycle.

The final objective of a wind turbine is to provide power to the grid. The control strategies designed must provide the maximum possible power (efficiency maximisation) whilst guaranteeing the structural integrity of the components and therefore extending the useful life of the entire system. The control system will have to decide the most appropriate set point for each point of the operation.

Therefore, this doctorate scholarship will be co-directed by the Department for **Mechanical Engineering at the UPV/EHU,** which will offer its knowledge on structural dynamics and mechatronics; and the **Offshore Renewable Energy** Group of the Energy and Environment Division at **TECNALIA**, with prior experience in the design of floating platforms, on one hand, and control strategies for renewable energy, on the other hand.

Candidate requirements:

- Degree and specialisation: Engineering. Hold a university Master's degree that allows access to the PhD scholarship programme prior to incorporation in the scholarship.
- Languages: English is essential.
- Others: Knowledge of programming, preferably Phyton, Matlab, C and/or VBA.

The following will be a plus:

- Knowledge of mechanics, control, hydrodynamics, aerodynamics, etc.
- Master's Dissertations in the field of offshore or onshore wind power will be positively evaluated.
- Teamworking skills
- Autonomy and initiative to put forward new ideas and implement them.

Further information and applications: http://bit.ly/2JTgjec