Title of the PhD thesis:

Vibration Reduction of an Offshore Wind Turbine Situated in a Seismic Area and Subjected to Environmental loads

Thesis subject:

Offshore wind turbines are increasingly being installed in seismic regions to harness the abundant wind energy available there. Offshore wind turbines are thin, poorly damped structures, and are highly sensitive to vibrations induced by the simultaneous actions of wind, wave and earthquake.

The recent construction of offshore wind turbines in seismic regions requires an assessment of the impact of the combined action of wind, wave and earthquake on these structures, taking into account possible soil liquefaction. This study may be divided into three parts:

The first part of the thesis involves the establishment of two 3D calculation models (a numerical model considering the soil as a continuum and a p-y model) of an offshore wind turbine, the numerical model being the reference model which will be used to justify the relevance of the simplified p-y model and which will be used in the dynamic analyses. The aim of the two 3D models is to be able to model the seismic effect and the effect of non-alignment of the various environmental loads (wind, waves and earthquake) and to study their impact on the structural and geotechnical responses of the wind turbine.

The second part of the thesis involves the implementation of a passive inertial-type vibration reduction device (Inerter-based resonant Vibration Absorber IVA) within the 3D model developed earlier, to attenuate excessive wind, wave and earthquake vibrations. Compared with conventional damping systems, IVAs have a significantly reduced secondary mass and stroke, making them easier to install in practice.

The third part involves the development, within the 3D model developed previously, of two semi-active and active control systems for the offshore wind turbine subjected to the combined loadings of wind, wave and earthquake, where soil degradation and structural damage may occur. In this case, the passive energy dissipation system becomes inadequate for the new natural frequencies of the wind turbine. The aim of this part is therefore to evaluate the effectiveness of the proposed semi-active and active controls for controlling the dynamic responses of the wind turbine using the 3D computational model, which takes into account the soil-foundation-structure interaction and the effect of soil degradation and structural damage.

Candidate profile: The candidate should have at least an Engineering degree (or equivalent) in Civil engineering or Mechanical engineering. He should demonstrate aptitude for research. The candidate should possess a good understanding of structural dynamics, geotechnical engineering & Control and Automation Engineering with a deep mathematical background. A candidate who demonstrates exceptional aptitude in one or more of these areas may be accorded preference. Ideally, the successful candidate should have skills in coding in MATLAB/Python, in structural modelling and dynamic analysis using standard finite-element software (e.g. ABAQUS, FLAC3D, OpenSees or similar), in simulating the dynamic response of structural and geotechnical systems.

Supervisors:

Abdul-Hamid Soubra, Nantes Université, Abed.Soubra@univ-nantes.fr ; Mourad.Aït-Ahmed, Nantes Université, Mourad.Ait-Ahmed@univ-nantes.fr; Agathoklis Giaralis, City University of London, Agathoklis.Giaralis.1@city.ac.uk

Location: The PhD candidate will be located in Nantes University (GeM Laboratory) at the Saint-Nazaire city.

Starting date: The PhD thesis will start on October 1st, 2023.

Funds: The thesis is funded by WEAMEC (Region Pays de la Loire and CARENE).

Salary per month: 1550 € net

To apply to the PhD position: Interested candidates are invited to send their CV, a motivation letter and their transcript during their study at the university via email to the three supervisors mentioned above by July 14, 2023.