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Dynamic characterization of offshore wind turbines supported on a jacket using Artificial Neural Networks

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The dynamic characterization of an offshore wind turbine (OWT) and its foundation is an important task within the design stage of the support structure. The system fundamental frequency should not coincide with that of the loads that affect it, otherwise resonance phenomena can conclude with the collapse of the structure or its deterioration due to fatigue [1]. Assuming a linear behaviour, the system fundamental frequency can be computed by solving the eingenvalue problem after defining the stiffness and mass global matrices. This procedure can become computationally expensive if soil-structure interaction (SSI) phenomena is taken into account. For this reason, a surrogate model based on Artificial Neural Networks (ANN) is proposed for estimating the fundamental frequency of the wind turbine assembly, jacket support structure and pile foundation considering SSI effects.

A dataset is generated to train the ANN. This synthetic data collects the characteristics of the OWT-jacket-foundation and its fundamental frequency, which is obtained by a finite element substructuring model. The SSI is reproduced through impedance functions computed through a previously developed continuum model [2]. Comparing the predictions of the ANN with the results obtained by the structural model, it is observed that this type of regression allows to reproduce in a sufficiently precise way the dependence of the fundamental frequency with respect to the variables that define the system. Thus the use of Machine Learning techniques, such as ANNs, makes it possible to take into account the system behaviour obtained by rigorous models in large-scale calculations that it would be unfeasible otherwise.

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