Wind turbine health monitoring

based on accelerometer data

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ABSTRACT

A structural health monitoring (SHM) system verifies the mechanical state of a structure to ensure its proper functioning and determines whether it needs some kind of maintenance. Thus, SHM for wind turbines (WT) in remote locations, as offshore, is crucial. Offshore wind farms are increasingly realized in water depths beyond 30 meters, where lattice support structures are an interesting option to withstand the severe environmental actions. In particular jackets appear to be a highly competitive substructure type with a wide range of applicability, from approximately 25 to 70 meters water depth. With no doubt, structural damage is a significant issue in these structures. Unlike on-shore structures or even shallow water structures, the access for regular monitoring and repair is not an easy option, in terms of both the cost and the accessibility. In this work, a methodology for the detection and classification of structural damages in offshore jacket-type WT is stated.

The proposed method relies on the paradigm that any damage in the structure produces changes in the vibrational response. However, as in [1], it is assumed that the only available excitation of the WT is the wind turbulence, so the input excitation is assumed to be unknown. Therefore, using only accelerometer information, data driven approaches for damage detection are compared and developed. The scheme of the proposed method can be summarized in the following steps: (*i*) the wind excitation is simulated as a Gaussian white noise and the data coming from the WT is collected using a set of accelerometers; (*ii*) the raw data is arranged in matrix form and pre-processed using mean-centered group-scaling [2]; (*iii*) principal component analysis (PCA) [3] is selected as a technique to reduce the dimensionality of the data and the computing time of the next step; finally, (*iv*) the quadratic-kernel support vector machine (SVM) is used as a classifier. The 5-fold cross-validation technique is employed to estimate the overall accuracy and to avoid over-fitting.

In order to experimentally validate the proposed approach, the damage detection strategy is applied to different types of predefined damage in a small-scale structure –an experimental laboratory tower modeling an offshore-fixed jacked-type wind turbine–. The results that have been obtained for these predefined damages are included and discussed to demonstrate the reliability of the proposed approach.

REFERENCES

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