Comment on wes-2021-76

Anonymous Referee #3

Referee comment on "Data-driven farm-wide fatigue estimation on jacket-foundation OWTs for multiple SHM setups" by Francisco d N Santos et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-76-RC3, 2021

This manuscript describes use of an ANN for estimating the fatigue damage rates due to fore-aft bending on the jacket foundation of offshore wind turbines. This allows for the prediction of farm-wide fatigue assessment without necessitating condition monitoring installations on all turbines. The motivation is thus to create a data-driven model that estimates fatigue loads as a more economic alternative to farm-wide condition monitoring. Metrics used for inputs to the ANN is calculated from SCADA data, 1Hz nacelle acceleration and estimated thrust loads.

The method is useful in that it estimates fatigue on turbines with no structural health monitoring installations. This can ultimately be used to inform life-extension decisions. This is a valuable contribution to the problem identified in the manuscript.

The work is interesting and well presented.

General comments:

There are some typing and/or grammatical errors that should be revised. For example, 'within the an offshore wind farm' in Line 114-115.

One of the unique aspects of this work is stated to be the use of ANN estimated thrust load as an input for the fatigue estimator (Line 72). It would then be sensible to compare the effect of including or excluding the thrust load on the accuracy of the fatigue estimation. Only one such comparison is possible in Section 3.2.2 between scenario D and

scenario F. The cross-validation for these scenarios however show that the inclusion of the thrust load increases the MAE which may result due to overfitting. This is briefly mentioned in Line 441-444, but for the farm wide evaluation (Section 4.3) the thrust load is included even though it has been shown to result in overfitting. It is recommended that the authors evaluate and discuss whether the use of estimated thrust load is beneficial to a model that can be used for farm-wide estimates or whether scenario D would not better address the goals of this work.

In addition, the impact of including/excluding thrust load is said to be studied in future work (Line 581). If the inclusion of the thrust load is indeed deemed to be unique to this work, it falls within the scope of this paper and should be addressed thoroughly.

Comments:

Line 118: Rotational speed is also referred to as RPM which is confusing as the unit in which rotation is measured is *cpm* and not *RPM*. Recommended use of only rotational speed.

Line 119: Unit of ambient temperature is given as ° which does not distinguish between °C and °F.

Line 368: This is the first time that reference is made to the X direction in the text. At that stage it was unclear what the X direction is. It was found that Figure 2 also refers to X and Y, but it might be clearer if the text mentions that X and Y is the measurement directions of the accelerometers (perhaps in Line 121-122). Possibly also show in a figure like Figure 16 how these directions are defined.

Line 388: Y vibration is said to be unnecessary. Is this due to yaw angles close to 0° or 180° for most data used during feature selection? If the yaw angle is close to 90° or 270°, the FA direction would be the same as the Y direction. Would this case not result in the Y SHM measurements to be better correlated to the fatigue? Perhaps the exclusion of Y measurements would not generalize for all conditions of the studied turbines or generalize well for all wind farms.

Line 424: The final scenario is that of the final instrumentation setup with only the selected features used as inputs for the ANN. It is recommended that an additional scenario is included in this section which uses the same instrumentation but no feature selection. This would be beneficial to see the impact of the feature selection on the errors for validation and cross-validation. This would then show the increased performance due to feature selection which is referred to in Line 229.

Line 451: The use of the word 'clearly' seems to contradict the initial understanding of Figure 10. This is evidenced by the need of the author to explain the lack of generalization in Line 452. If one were to choose a case that is generally 'best' based on Figure 10, it seems that scenario G performs better. Please explain how these results are used to determine the superiority of scenario H.

Line 471: Is the 8000 datapoints each selected randomly or is a period of 8000 consecutive datapoints selected randomly?