Review of WES-2024-130

Sensitivity analysis of numerical modeling input parameters on floating offshore wind turbine loads in extreme idling conditions

The study proposes a global sensitivity analysis to model input parameters to floating wind turbine numerical models. The study analyses the effect on extreme and fatigue loads in a selection of non-operational IEC load cases of more than 50 input parameters. The study is well written and the topic is very relevant. Such an analysis can help quantify uncertainties in numerical input parameter. The outcomes can help inform numerical modelers and also technical experts. The study is quite intricate and various aspects of it are complex. Some of the suggestions given below are directly linked to such complexity. Some remarks and suggestions to improve the draft submission are given below:

L98: IEC load cases do not typically consider Veer. Coul the authors comment on why they considered it in this study?

L107-L117: Distinguishing between physical and numerical instabilities in idling simulations can be challenging for numerical modelers. Increasing damping ratio as suggested in this study may sound somewhat arbitrary. It would be of great value to add any suggestions or experience-driven guidance on this. Connected to this, why was this parameter not considered in the sensitivity analysis as tower damping was?

L133: is there a reason for choosing 10%? Was this based on preliminary analyses? The question arises from the fact that 10% is arguably not that small of a variation

L137: So each simulation uses a different wind/wave seed and the number of simulations is high enough to ensure statistical convergence in each test point?

L153: It is important to weigh variations that are more likely to generate ultimate loading more, and adding the ultimate load to the variation in QOI is a way of doing this. However, this manuscript focuses on sensitivity to input parameters in uncertain engineering models. In principle, the extreme load that is added to the variation could also be uncertain, and somewhat skew the results of his analysis. Did authors observe relevant differences in the conclusions if the ultimate load for each DLC is not added to the variation in QOI?

L172: What do you mean for “The coefficients at the mid-span sections between the tip and the root use a coefficient modification that is linearly interpolated between the tip and root.”? The coefficients of mid-span airfoils are modified from their respective polars proportionally to their distance from tip/root? Please clarify in the text

Fig. 7: This figure could be commented in more depth. What is the cause of the bi-modal distribution in Humboldt Bay? Swell? In Gulf of Maine the waves also do not appear to be wind driven as one would expect wind-wave misalignment close to zero at high wind speeds (LC 6.1-6.5)

L273, Fig. 9 – IEC recommends the IFORM method to derive environmental contours, how does this differ to the principal component analysis performed here? The entire paragraph L273-L282 could benefit from some additional clarity as it is not clear for me what underlying complexity the authors are trying to solve here.

This may sound surprising, but I am somewhat uncertain about what is being shown in Figures 11-14. If I understand correctly Eq. 3 is used to compute the EE value for each parameter variation in each DLC. For each parameter multiple variations around multiple “mean” values are imposed. What is the rationale for post-processing this data? Only the most relevant variations need to be extracted? I would suggest expanding

L316-318 as I find this part quite intricate for a fist time reader. If possible, an equation to reference when computing the “significant Ultimate Events” would go a long way here.

L337: Possibly due to the uncertainty highlighted in my previous comment, what is the need for normalization?

L363-L382: If, as appears, the directionality of wind and waves matter, rather than the misalignment, then the absolute orientation of the platform also matters. This would make it quite hard to define “general” load cases, which has been the industry-standard approach up to this point. Perhaps a comment on this aspect could be added here or in the conclusions.

Conclusions: It is particularly interesting that directionality parameters seem to have a large influence on quantities which should compensate for this by considering the sum of X and Y moments, such as the total tower base bending moment. An explanation on why this may be would be nice to see in the conclusions.