“Impact of Wake Impingement on the Fatigue Loads in the Main Bearings and Blades of Offshore Wind Turbines” (https://doi.org/10.5194/wes-2026-13) In this work, the impact of wake effects on the fatigue loads of offshore wind turbines is investigated. Two different loads are considered, the main bearing and the blade root bending moments. Loads are determined using openFAST in combination with FAST.Farm. Analyses are conducted for a two-turbine configuration as well as a real farm layout.

Analyzing the wake effects on fatigue loads in wind farms is a topic of high relevance for industry but also in research. The presented work addresses several smaller research gaps. Although no fundamentally new ideas are presented, the work is definitely of interest for the readers of WES. However, some issues must be resolved before I can recommend publication in WES.

Major comments:

1) Section 2.1.1: In my opinion, the explanations in this section are not sufficient. Surely, you do not have to describe the turbine model in detail again. However, important aspects should be mentioned. For example,

a. You use a monopile, correct? – Yes, a monopile is used. A better description of the model will be added.

b. Do you model waves? If yes, how? – Waves are generated using hydrodynamics based on a Jonswap wave spectrum, which is based on wave buoy measurements close to the wind farm. An explanation and definition of the wave realization of the wave field will be added.

c. What simulation length do you use and do you remove initial transients at the beginning of each simulation? - 1000s simulations are run in Fast.FARM of which the first 400s are removed to allow the wakes to fully develop within the farm. The remaining 600s of the simulation are then used for the load calculation.

2) If I am not mistaken, Eq. (5) to (9) do not fit the force/moment definitions in Fig. 1. For example, Fig. 1a shows that $Fx,s = -Fx,MBs$ (both arrows point in the same direction so that $\sum Fx = Fx,s + Fx,MBs = 0$). However, Eq. (9) states that $Fx,s = Fx,MBs$.

The equations represent the resulting reaction loads in the bearings, while the figures show the loads onto the main shaft. This will be made clearer, we see how this can lead to confusion for the reader.

3) L. 178 (and others): You frequently write “blade root DEL”. However, you do not specify which one. I assume that you mean the flapwise moment. However, it is not clear. This becomes even more problematic, as you use the “out-of-plane (OoP)” moment in Fig. 7. Flapwise and OoP are not the same, e.g., if the turbine starts to pitch the blades. Hence, be very clear in which DEL you use/show. When you use the flapwise DEL, this might have an influence on your results above rated wind speed. Due to reduced wind speeds in wake conditions, the turbine will pitch the blades less. Therefore, the flapwise moment remains “close to the OoP moment”. This is something you might need to discuss/consider.

For the influence of wake overlap and turbine spacing on the blade root fatigue loads, the blade DEL is calculated as the resulting moment from the flapwise and edgewise bending moments. For figure 7, specifically, only the out-of-plane bending moments are used, as the imbalance over the rotor and the resulting yaw moment at the shaft tip are analysed. A clearer distinction between the DEL and the out-of-plane bending moments will be made. And the calculation of the DEL will be clarified.

4) Eq. (11): At least for the DEL, this weighting is not correct. A correct weighting is given for example by Dimitrov et al. (https://doi.org/10.5194/wes-3-767-2018). You should use such a weighting: ▯▯FL =($\sum w\ FLm$)1 m . Otherwise, low DELs are weighted too much, especially for high exponents m. I am not sure whether this is relevant for the bearing load as well. Please, check this carefully.

This is a great reference and will be implemented in the reviewed paper, also checking for the bearing loads.

Minor comments:

5) In my opinion, the innovation of the paper could be stated even more clearly in the introduction. In line 34 37, the differences between this study and prior studies remain a bit unclear. In line 56-58, the novelty is stated explicitly. However, the statement in these lines is not self-explanatory.

This part will be clarified.

6) L. 49: You state that one goal of your work is to deliver “an exemplary damage map”. However, how generally valid can such a map be if it is just based on a single wind farm layout? If it is not generally valid, for what purposes is it still useful?

It is useful to the operator to possess a lookup table of the expected fatigue loads as a function of relative turbine position. The operator can estimate the historic fatigue loading based on operational data or incorporate the lookup table into health-aware control strategies. The lookup table has to be simulated for each wind farm individually if its values are to be used in a control strategy, for example.

7) Section 2.2.1: You should briefly discuss whether linear damage accumulation is suitable for blades. You can do this in Section 2.2.1 or in the "Conclusions" where you already mention the composite material of blades.

A brief discussion will be added for this in Section 2.2.1

8) Eq. (1): Did you apply a Goodman correction or something similar to account for time series with a non zero mean value?

Goodman correction was applied, which will be stated accordingly.

9) Eq. (2) and (3): Make clear where these equations come from.

References for the equations will be added.

10) L. 119: I think Fx, Fy and Fz have not been explained so far.

Fx, Fy and Fz will be clearly explained.

11) L. 130-140: Do you know or at least have an idea of how relevant the simplification of the selected (in contrast to the real) bearings is?

The bearings are selected to be representative of what is seen in the actual machine; it is expected that the qualitative behavior is similar to that of the real bearings, while it is difficult to estimate the quantitative differences.

12) Table 2: Make clear, where this data comes from. In the text, it is somehow (but not clearly) mentioned, but here, it is missing.

The source of the data will be added to the table description /header

13) L. 155-159: You nicely discuss that the metrics are not perfect. However, you do not state why you use them if they are not perfect.

A short part on why those metrics are used will be added.

14) Fig. 3: In my opinion, it would be very nice to see how wind speeds and turbulence intensity change at T1 for different crossflow offsets and turbine spacings (could be

shown in an appendix using a similar plot as Fig. 3). This would help the reader to understand the connection between reduced wind speed and change in DEL, while the changed turbulence intensity seems to have no significant effect.

A figure showing turbulence and wind speed will be added to the appendix or to the paper, as other reviews have proposed analysing the influence of turbulence intensity in the study.

15) Fig. 3: The different colour bars in Fig. 3a and 3b are quite misleading. It seems as if the change for wind speeds above rated is much smaller in Fig. 3b, although it should be more or less the same, as the produced energy above rated remains (nearly) the same.

The colorbars will be reworked such that the two plots use the same scaling if possible.

16) Fig. 3: How is the interpolation done?

Linear.

17) Fig. 4: Perhaps, you can briefly explain “Case 1” and “Case 2” in the caption so that the figure is self explanatory.

Case 1 and Case 2 will be explained in the caption

18) Conclusion: You might discuss the limitations of your work in more detail, e.g., just one type of turbine, just one farm layout, simplified shaft models, just one turbulent wind field (random seed) per load case, no/simplified consideration of wave loads, ...

The discussion will be extended to incorporate the named points.

Typos, etc.: 19) Table 3: You forgot 16m/s. 20) Fig. 5: In the figure titles, it must be “$= 0.7D$” and “$= -0.7D$”