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Comment on wes-2021-152

Anonymous Referee #1

Referee comment on "Multifidelity multiobjective optimization for wake-steering strategies" by Julian Quick et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-152-RC1, 2022

General comments :

The manuscript explores the extremely relevant topic of multi-objective wake steering optimization, while considering the trade-offs between power produced and structural fatigue for turbines operating in yawed states. The text is well written, with the aims, methodology, results and conclusions presented in a clear and concise manner. The quality of language and grammar used in the text is excellent as well.

The work would benefit from the following clarifications and details :

In section 3.1, the authors present that 7D rotor diameters were chosen as the spacing between the two turbines, but no justification or references were provided as to why this distance was chosen. Additionally, no reasoning is provided for the chosen wind speed of 7.5 m/s, and the details of the inflow turbulent intensity at hub height are missing. As all of these parameters (turbine spacing, inflow speed, turbulence intensity) would have a significant impact on wake recovery and hence resulting fatigue and power production of the downstream turbines, further clarification on the impact of these parameters on the methodology and results would be interesting to see.

The numerical modeling section could also benefit with the inclusion of performance curves, such as power/rotational speed/pitch against wind speed and yaw angles. By comparing such curves against reference values from the turbine report, it can be confirmed that the turbine and implemented controller in the numerical set-up are operating correctly.

The moments in the paper are evaluated by determining the aerodynamic forces along the

actuator line elements according to the equation 25. The authors however do not go into further detail about the blade structure and whether the blade material properties and flexibility are accounted for in their simulations. Blade deformation and structural damping could significantly affect the amplitude of stress reversals and hence the resulting fatigue damage. Furthermore, no information is provided as to why only the blade flapwise bending moments are considered in this study, and the edgewise moments and tower loads are not considered.

Since both the high-fidelity and low-fidelity simulations are run for the short time durations of 1,200 s and 400s, the measure of accuracy of the computed time averaged power production and DEL could suffer from the small sample sizes. Figures 4 and 5 show the output power and loads for all the simulations, however the range of uncertainty of these values is not addressed. The results could benefit from a supplementary figure showing the uncertainty on the computed power and loads, using a statistical tool such as bootstrapping. Additionally, since the flow-through time is reported to be 301 seconds for the turbine set-up, is the duration of 400 seconds of the low-fidelity model sufficient considering initial transients?

While formulating the loading objective in line 225, page 9, it is not clear why a factor of '10' is subtracted from the loads.

Table two summarizes the total power gain for different yaw angles, however it could be interesting to see an analysis on the power production by the individual turbines as well, as shown for loads in Figure 8.