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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Surrogate based aeroelastic design optimization of tip extensions on a modern 10MW wind turbine" *by* Thanasis Barlas et al.

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The article being reviewed details a novel tip design and optimization approach for wind turbine blades. It outlines in great detail an optimization framework for blade tip extension based on surrogate aeroelastic modelling. Tip extensions are parameterized using 11 variables on 10 additional structural and aerodynamic sections. An academic wind turbine is modelled in an aeroelastic design code and simulations are done using a near wake module. A surrogate model is fitted to data from full aeroelastic simulations in extreme turbulent conditions. The tip optimization method is seeking to increase power production while maintaining neutral loading. To achieve this the

objective function op the optimization is a weighted sum of the generator power and the ultimate blade root flapwise bending moment. The optimization results are evaluated for AEP in both IEC wind class I and III. Further performance is evaluated using DLC1.3 for higher turbulence levels using the near wake model that is used in creating the surrogate model. And furthermore, it is compared with two different fidelity models namely: a BEM model implemented in HAWC2 (lower fidelity) and a lifiting line method implemented in MIRAS (higher fidelity). From the resulting figures and explanation of the results it becomes clear that for lower turbulence the solvers show good agreement between blade root bending moments and generator power. With increasing turbulence the agreement between solvers shows greater difference, which should be considered in future work. While the higher turbulence results require more research the overall results show high potential for this tip extension design process. From the referees point of view the article is sufficiently well written for reproduction of the study by other scientists. This study will add significantly to the implementation of rotor up-scaling and the application of novel tip design in large rotor concepts. The increase in AEP of up to 6% will add to lower LCOE of future wind turbines.

Considering the above I recommend publishing of this study taking into consideration the question below and a few (very) minor textual and formatting comments posted below.

Question: In line 142 to 144 it is mentioned that, besides the new twist distribution, the new tip design is realistic for application in new blades. The optimized results for the twist distribution do not show a smooth continuation of the maximum values inboard of the baseline tip. The referee would find it interesting to see the impact on optimization results, the corresponding aerodynamic performance, and blade loading when considering a realistic twist distribution in the optimization of a new tip design. This could be part of future work which might have large implications in a new tip design.

Textual and formatting comments:

- Consider reformatting such that the following lines are attached to their paragraph and not in between or after figures on another page: lines 143&144, 177&178

- Table 1. Consider adding line explaining that min values are for Tip 2 in Figure 2 and max values are for Tip 1. This is not mentioned and makes the legend of figure 2 slightly confusing.

- Line 110, consider rephrasing to "When the increase in loads is higher than 2%....."

- Line 115, rephrase to "The minimum sample size used is 3*d+1, where......"

- Line 133, consider rephrasing to "A Pareto front is clearly visible, with....."

- Line 171, Minimum pitch angle is reduced to -1 degrees. However Table 2 shows opt Pitch off = 1 degrees. Is this a typo?

- Caption table 4, change per cent to percentages.

- Line 185, add "figure" before 15 such that: "..... moment signal is presented in figure 15".

- Line 191, rephrase to "A detailed analysis......"

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