

Wind Energ. Sci. Discuss., referee comment RC2
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Comment on wes-2021-37

Adam Wise (Referee)

Referee comment on "FAST.Farm load validation for single wake situations at alpha ventus" by Matthias Kretschmer et al., Wind Energ. Sci. Discuss.,
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General Comments

This paper aims to validate the tool FAST.Farm for single wake situations at the Alpha Ventus Wind Farm. The novelty in this work is that a new wake-added turbulence model is added to the tool FAST.Farm, which improves agreement especially in lower wind speeds when the wake-added contribution of turbulence is most significant. This paper analyzes measurements from the FINO1 met mast just upstream of the farm to determine the environmental conditions for the simulations. The data is filtered and categorized by stability and wind speed, then statistics are fed into TurbSim to conduct "one-to-one" simulations. The paper is mostly well-written; however, the manuscript needs minor proofreading/editing to correct small grammatical errors throughout. This work improves FAST.Farm's usability, as validation with utility-scale measurements, such as tower and blade loads in this case, is very important. Specific scientific questions and a number of technical suggestions are listed below.

Specific Suggestions and Questions

- It would help to provide more detail on the implementation of wake-added turbulence so that the reader does not need to open another reference or the IEC standard. The implementation of wake-added turbulence is one of the more important aspects of this paper so more detail should be provided in Section 2.1.1.
- Line 82: Wake-added turbulence is generated using the Mann Model, but the ambient wind is generated using TurbSim. Please comment on why this is appropriate. Why is wake-added turbulence not just added with TurbSim? There are fundamental differences in the coherent structures between the two methods for generating synthetic turbulence (perhaps cite Bachynski and Eliassen 2018 as well as the already cited Nybø 2020).
- Section 2.1.1: Why are the empirical coefficients the authors calibrated so different than the recommended values by the IEC? Is this site or turbine specific? Also, please

provide example calculations for Eq. 1 so that the reader has an idea of how much the velocity components might scale for the given environmental conditions.

- Additionally regarding Section 2.1.1, the figures in Appendix A would be more helpful if they are moved to the body of the paper, i.e. to Section 2.1.1. Additionally, please add PSDs for FAST.Farm to show the difference in the energy content with and without wake-added turbulence.
- Figure 2: please comment on why there are discrepancies for OpenFAST compared to AV4 for wind speeds above 16 m/s. Alternatively, the data from wind speeds above 16 m/s could be removed. If the data are included, the paper should discuss why OpenFAST is underperforming in this regime.
- Section 2.6: Please provide information regarding the grid resolution used for the setup of the simulations. Details are needed for the dx , dy , dz used for the TurbSim wind fields, the Mann wind fields (used for the wake-added turbulence), the low-res domain in FAST.Farm and for the high-res domain around each turbine. If the simulations are run for just 10 minutes because 10-minute statistics are used, the paper should state that each realization from TurbSim is 10 minutes long. Is there a spin-up period included, since it takes some time for the wake to advect from AV4 to AV5? These are critical parameters that add to the credibility of the model. The paper should describe the research done such that the modeling details are clear and reproducible by future researchers.

Minor comments

- Lines 5 and 6: Please quantify the agreement between FAST.Farm and the measurements in the abstract.
- Line 40 (and so on): Fino 1 should be written as FINO1.
- Line 93 (and so on): Alpha Ventus should be capitalized
- Line 94: Remove the word "form"
- Line 96: "Research" should not be capitalized
- Table 1 should mention the Pena reference for how σ_v and σ_w are determined
- Line 133: "Sea state is measured in terms of significant wave height and peak wave period." How were the wave height and peak wave period measured at FINO1? Please state this in the manuscript.
- Line 183: Are six random and uncorrelated sea states also used for the simulations? It's unclear how the wave loading is represented for both the OpenFAST and the FAST.Farm simulations. Please clarify.
- Line 204: Could the freestream sector of 240-257 deg be shaded in a separate color for Figure 1.
- Line 259: approximately should be spelled out and factor 2 should be factor 2.0
- Line 263: again should be factor 2.0.
- Line 286: The higher energy content from 0.35-0.4 Hz is 3P, correct? Any ideas on why FAST.Farm is underestimating this excitation?
- Line 295: In addition to Shaler et al. 2019, Wise et al. 2020 should also be cited as it discusses the effect of coherence on wake meandering for the DWM in FAST.Farm.
- Line 299: larger coherent structures, not necessarily more.
- Line 311: km should not be italicized.
- Line 312: remove the word "order".
- Line 319: "free- and downstream" should be freestream and downstream.
- Line 326: Please add a sentence that succinctly describes the wake-added turbulence method used in this paper.

- Careful proofreading to correct minor grammatical errors is needed throughout the manuscript.