

Wind Energ. Sci. Discuss., referee comment RC1  
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## **Comment on wes-2022-62**

Anonymous Referee #1

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Referee comment on "Evaluation of lidar-assisted wind turbine control under various turbulence characteristics" by Feng Guo et al., Wind Energ. Sci. Discuss.,  
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It is an interesting research work to evaluate the lidar-assisted wind turbine control under various turbulence characteristics using a four-beam lidar and the NREL 5.0 MW reference turbine, which could be beneficial to the Lidar-assisted wind turbine control community. The paper is well organized and written. I recommend to accept the paper after considering and modifications are made according to the following comments:

### **Grammar and typos:**

Line 24: missing whitespace between control ... (CPFF), please also cross-check in the whole content of the paper, this appears in many places.  
Line 37: averaging -> average  
Line 55: ... (Schlipf, 2015) uses ... change to ... Schlipf uses ...  
Line 81: "... designing ..." -> design  
Line 82: present -> presents  
Line 90: structure -> structures  
line 106 a -> an  
line 129: yz plane -> yz-plane  
line 175: "... Simley and Pao Simley and Pao (2015) ..." I guess the bracket around the cited reference is missing  
line 176: what is  $I_h$ ? it should be "In" right?  
line 190: Never use a symbol, e.g., "L" to start a sentence.  
line 276: propagates -> propagate  
line 277: try to replace semi-column with comma when separating the cited references. This applies to all the context of your paper. Please cross check all of them.  
line 305: is -> are  
line 308: is -> are,  
line 326: frequency -> frequencies, are -> is. cutoff -> cut-off  
line 327: that -> those  
line 340: delete "alone"  
line 395: contributed -> affected?  
line 400: are -> is

line 477: by -> in?

line 517: "Introduction the FF pitch ..." -> "Introducing the FF pitch ..." or "Introduction of the FF pitch ..."

line 557: "... two turbulence ..." -> "... two turbulence model ..."

line 558: "... provided ..." -> "... suggested ..."

line 570 - 571: "... We further analyzed the transfer function, which is important for designing a filter, which removes uncorrelated content in the signal for lidar-assisted control." Please consider to rewrite this sentence.

line 593: "Overall, with this work ..." -> "... with this work ..."

## General comments:

1. line 43 to 45: the author states: "... two turbulence models are commonly used ...," But later 3 models are mentioned in the following sentence "... they are the Mann uniform shear model Mann (1994) and the Kaimal spectra Kaimal et al. (1972) and exponential coherence model (hereafter referred as to Mann model and Kaimal model respectively) ..."
2. line 68 to 69: "... The length scale can have an impact on the power spectrum and turbulence spatial coherence." could you show an example to demonstrate this?
3. Line 91: suggest to use vector notation for 'x', e.g.,  $\vec{x}$
4. line 100: what is  $\Phi_{ij}(k)$  in Equation 3?
5. Line 162: Please double check the equation 15, the symbol  $F_{11}(k_1)$  is wrongly typed in Latex.
6. Sometimes, "evoturb" is used in the context, sometimes "evoTurb" is used, please unify them
7. line 190 - 194: This description is redundate, because this has been mentioned in the introduction section
8. line 210 - 211: "... Except for a relatively larger error for the v component auto-spectrum under very unstable stability, the rest fittings show very good agreements. ...", I don't see this conclusion in Figure 2, Please double check this statement.
9. line 234 - 236: "... we summarize the lidar wind preview quality for the investigated four-beam lidar and the NREL 5.0MW reference turbine under different atmospheric stability classes. ..." what do you want to express? Maybe the author wants to express "the lidar wind preview quality for the NREL 5MW reference turbine under different atmospheric stability classes"?
10. line 237: section 3.1, the procedure of calculating the "Turbine-estimated rotor effective wind speed" is missing. How do you get " $u_1(x)$ "? by EKF estimator or other method?
11. line 309 - 310: "... The coherence in the unstable case is especially lower using the Kaimal model, which can be caused by the direct product method ...". Do you have any reference to support this statement?
12. line 315: Please consider to re-formulate this sentence. "... If a filter with the gain  $GRL(f)$  turns out to be an optimal Wiener filter (Simley and Pao, 2013; Wiener et al., 1964), which results in minimal output variance for a multi-inputs multi-outputs system. ...". This sentence does mean anything.
13. line 330 - 334: what about the cut-off frequency for different mean wind speed other than 16 m/s? The author needs to specify this.
14. line 374: equation 36, why the derivative of steady-state pitch angle is calculated with respect to Turbine estimated Rotor Effective Wind Speed ( $u_{RR}$ )? and multiplied with ( $u_{LL}$ ) makes the equation mathmatically not exactly correct. What about using the Lidar estimated REWS when evaluating the derivative of steady-state pitch angle?

15. line 408: "... 4096×11×64×64 grid points, corresponding to the time, and the x, y and z directions ...". This means to me only 11 grid points in the x direction? (I suppose x-direction is the u-component direction). This seems to me too less grid points
16. In Figure 7, the time series of generator power should not have such kind of relative large oscillation because the author has mentioned that the constant Power mode (see line 367) is used in the simulation for above rated wind speed and 16 m/s mean wind speed should well above rated and has less probability to be at below rated wind. Could you please explain this in your paper?
17. The followed up comments is as the follows: line 450 - 452: "... Lastly, the generator power is shown in panel (g) where much less power fluctuation is observed in FFFB control. Because the power fluctuation is highly coupled with the rotor speed fluctuation, the less fluctuating power can be expected from the less rotor speed fluctuation in FFFB control." This statement is not correct. As it was mentioned before, the constant power mode is used, what fluctuated should be the generator torque and coupled to the rotor speed variations.
18. line 505 - 509: The statement is fair. It could be better to add some suggestions on how to solve this issue.
19. line 512 - 513: "... In the stable stability, the reduction is better at 14 ms<sup>-1</sup>, where the value is close to 4%, and it drops to 2% by higher wind speeds.". Does this mean for the stable atmosphere case, the probability of the wind speed lying in the transition range between below rated and above rate is lower than that of the unstable atmosphere case? Adding a probability exceedance plot should help the discussion better.
20. The discussion between line 522 and line 524 should be explained. Please see the comments number 16 and 17.
21. line 569 - 570: "... The coherence using the Mann model is generally higher in all atmospheric stability classes than the coherence using the Kaimal model. ...". For larger turbine, e.g., DTU10MW turbine, the coherence using the Mann model is generally much lower than the one using Kaimal model. The author needs to justify this in the context of his paper.