Review of the manuscript wes-2020-104, entitled "Wind turbine load validation in wakes using field reconstruction techniques and nacelle lidar wind retrieval", by D. Conti, V. Pettas, N. Dimitrov, A. Penha.

This manuscript proposes two methods for evaluating rotor loads under wake conditions. The work is primarily based on synthetic data generated through Mann's model and imposing modeled wake velocity deficits for different incoming wind speed and turbulence intensity.

I struggled to read through the entire manuscript and complete my review due to the cumbersome writing, lack of rigor of some statements and, sometimes, excessive technical details and jargons making more difficult the text comprehension. These are my main comments:

- In my opinion, this manuscript requires a major rewriting to sharpen its focus, remove jargons, and increase rigor in the description of the work.
- Many statements are not precise or incorrect, which makes the presentation of the work very cumbersome.
- This work uses a statistical approach to inject lidar data (here only simulated) in an existing velocity field through a technique proposed by the same authors in Dimitrov and Natarajan (2017). As shown in Figs. 4 and 12, this can produce reasonable characteristics of variance and spectra; however, it is far to be considered a data-assimilation technique (see more comments below). Maybe this method can be useful for wind energy applications, but it is highly below current standards for the turbulence/fluid mechanics community.

Please find below some comments, especially for the first three sections, which might help to rework the manuscript.

Comments:

1. The abstract should be sharpened to clarify the contribution of this manuscript and highlight the results achieved. There are too many details that result to be confusing without reading first the text in detail, see e.g., the "target observations", the baseline, etc.
2. L20, "*The wake-induced velocity deficit and its spatial displacement*…", just call it meandering.
3. L28, "*For the purpose of load validation, the IEC 61400-1 standard (IEC, 2019) recommends engineering wake models, which ensures low computational effort and an acceptable level of accuracy.*" This sentence can be rephrased. It sounds in contradiction with the previous paragraph. Maybe you can say that detailed predictions of wake-generated turbulence can be achieved with LES; however, the required computational cost makes engineering wake models a practical alternative.
4. L29, spell out DWM the first time in the text, even though you already mentioned it in the abstract.
5. L 54, "*wake deficit characteristics and their motions*": the motion of the wake deficit characteristics has no sense to me. Please clarify what you are trying to explain.
6. L56-59. Again, the description of the work is very confusing. If I am not mistaken, you compare the load predictions obtained with the two proposed models against those obtained by

injecting to the aeroelastic code more classical predictions obtained through the DWM model. Then, at L62 it is stated "*the load prediction obtained using lidar-reconstructed wake flow fields is as accurate or superior than that obtained with the DWM mode*". How can you get better accuracy of your benchmark dataset? At the very best, you can match those data with your new models.

7. L60, "*two sets of independent turbulence seed realizations*", the meaning of this is not clear.

8. L80-82. I disagree that you can quantify the statistical uncertainty of a turbulent process only by comparing two simulations. Furthermore, differences between the two simulations can be ascribed to both turbulence and wake meandering. How did you quantify the statistical distribution of your samples? How do you define the error between the two simulations? What statistical tests did you use to quantify the uncertainty?

9. L83-84, "*we use a virtual lidar simulator that scans the target wake fields, and, through a field reconstruction technique, incorporates these samples in a random turbulence seed from set B"*. This is quite an obscure description of your research! What field reconstruction technique? How do you incorporate samples from one simulation in the other one?

10. L 103, The statistical uncertainty (i.e., standard deviation of the bias) ? I have never seen this definition of uncertainty. Provide references, if any.

11. L 117, "wave vector with the wavenumbers in" at least remove wave.

12. Sect 3.2 is a single paragraph with 20 lines, a great exercise for diving apnea training!

13. L144-L148 and Fig. 1. You are presenting the results of simulations without providing any sort of basic description or references. For instance, how did you get the Ct of the turbine as a function of incoming wind speed, what incoming velocity did you use for the simulations with different turbulence intensity? What spatial resolution do you have in your data?

14. Eq. 4, How did you select the standard deviation of the Gaussian weighting function? Why did you choose a Gaussian function to simulate the spatial averaging? Can you provide references? More realistic functions have been proposed in the past, see e.g., work by Mann.

15. L156, this sentence "*The u-velocity is computed from the projection of VLOS,eq onto the longitudinal axis, i.e., the v- and w-velocity components are neglected in the field reconstruction*" is not correct unless you mention the constraints used in the angle difference between the velocity vector and the LOS vector. I guess we all agree that if the LOS vector is perpendicular to *u,* the LOS velocity is zero, but *u* is not.

16. L 164, "*8192×32×32 (x,y,z)*" What is the corresponding spatial domain with respect to the used reference frame?

17. L 166, "*These dimensions ensure an adequate turbulence field for a 10 min wind field simulation over a large rotor*" How did you assess this statement through the simulation data? Please add these details.

18. L 171, maybe continuous wave (CW).

19. L 170-188. This review of different lidars is not needed because this work is mainly numerical. Please remove this part and only describe the scanning strategy considered.

20. L 196, what is a scan radius? Please define it.

21. In Eq. 5 and 6, I guess you need to add time as an independent variable.

22. L 219, "in Eq. (19) in Madsen et al. (2010)" I suggest to add this equation in the manuscript.

23. L 223, The meaning of point 2 is unclear.

24. L 224, What velocity fluctuations with reference to Eq. 5?

25. L 226. Can you please define what are these turbulence seeds for set A and set B. To the best of my knowledge, turbulence seed is not mentioned in any turbulence book.

26. L 245 “*that maintains the covariance and coherence properties of the unconstrained field ˜g(r)*” What about fulfilling the Navier-Stokes equations? Is this a real turbulent flow or only a collection of random numbers? Looking at Eqs. 7 and 8, I guess this is true for a random time-series. However, you cannot call these signals “turbulence”. Other constraints and more sophisticated data-assimilation techniques should be considered to generate a turbulence field (see e.g., P. Bauweraerts, J. Meyers, J. Fluid Mech., Reconstruction of turbulent flow fields from lidar measurements using large-eddy simulation, 906, A17, 2020).

27. There might be an inconsistency between Eq. 10 and Eq. 11., i.e., U_lidar=U_WDS? Furthermore, Eq. 11, states that Kdef,lidar is not only the imposed velocity deficit kdef, WDS with a random perturbation added u'_B. If that the case, then Eq. 11 is trivial and a simpler description can be provided.

28. L 298, “explained variance”? This might be only acceptable as jargon among lab mates not for a scientific publication.

29. L 373, what does is the list 8, 7, 7, 6,6,6 ,,,etc mean?