Review of wes-2024-188

Field comparison of load-based wind turbine wake tracking with a scanning lidar reference

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Dear Authors,

I very much enjoyed reading and reviewing your paper. I think it is a very good piece of work, worthy of publication in the *Wind Energy Science* Journal after minor revisions. Especially, I have found the results section very nice. The different events captured by the Lidar and EKF are well explained. In contrast, the Methodology section could deserve more clarifications. I would thus suggest revising mostly the clarity and accuracy in the methodology section, as per the major and minor comments below. If these comments can be addressed, I support a publication in WES.

Best regards,

Reviewer

Major comments:

Sect. 1 Introduction: the literature review could deserve to be expanded. I think the list of prior works is good and complete, but some more sentences for each justifying the difference with the present work could be good, to understand better the novelty brought here already from this introduction part.

Sect. 2.2.1 General EKF setup: you start already defining many abstracts variables and mathematical model, before the main problem has been even clarified, as:

- The physics involved (wake deficit, dynamic wake meandering, wake deflection, etc.)
- The quantities that must be estimated (wake position etc.) and why they are relevant for which applications.
- The main inputs that you use (blade root loads yaw tilt col) and theoretical explanation why they include the relevant information you try to predict.

I think a subsection clarifying these points would be very helpful before the current Sect. 2.2.1.

Line 212-213: *"Only one stochastic seed per wind field proved sufficient, since the effect of ambient turbulence is low in comparison to the effect of the wake."* I think this is a very dangerous and misleading statement, since ambient turbulence directly affects the effect of the wake when one considers dynamic environment. It is a core element of the DWM model that the ambient turbulence is the main driver of the whole wake propagation and dynamic meandering. Hence, various turbulent seeds can produce very different wake effects based on the DWM. I am quite skeptical that a single seed is enough for convergence. Please justify this statement more in detail, ideally with adding numerical tests and convergence study (possibly as Appendix). Furthermore, when comparing synthetic simulation data with field measurements (as the topic of this paper), extra attention must be given to seed-to-seed variability and binning approaches for measurements data, to obtain statistically converged data. Please elaborate on this.

In Sect. 2.2.1 you present the state vector as four parameters (yw, zw, vc and wc). Yet, in the whole results part you only show predictions of the lateral wake position (yw). I miss the part where you justify why you only look at yw for the results. Especially because this wind farm has the particularity of having two different hub heights, results on the vertical wake position (zw) could be very interesting to include (and for the application perspective, the vertical position is as important as the lateral one).

Minor comments:

Sect. 2.1 Field experiment: I think there should be proper citations added for each of the measurement devices mentioned (Trimble type 3 Zephyr mode, Thies Clima type 4.3352.00.400, Leosphere WindCube 200S, etc.) in the references.

Sect. 2.1 last paragraph: you mention the active wake steering control applied on WT1 but it would be great to have the yaw schedule added as a plot here for more clarity (scheduled yaw angle of WT1 by wind direction).

Sect. 2.2 a proper citation for EKF is missing.

Line 284: probably a typo (Myaw, Myaw) twice.

Line 244. Typo reference (?)

Fig. 15: This figure is nice, but it is a bit misleading to represent both metrics as parallel bars, since the RMSE should be as low as possible and the inRange should be as high as possible. Please consider possible review of this point (possibly by redefining the metric “inRange” into “NotInRange” so that it should also be as low as possible). The figure would thus be much easier to interpret in my opinion.

Thanks!