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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Online model calibration for a simplified LES model in pursuit of real-time closed-loop wind farm control" *by* Bart Doekemeijer et al.

Anonymous Referee #2

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This paper is about state estimation for a simplified CFD model, aiming to be used in a feedback control setting.

General comments: The paper is interesting, but way too long compared to its actual contribution. I suggest it is reconsidered for publication after major review.

Major comments:

1. My main comment is: reduce the length substantially to increase the readability, but most importantly, to clarify the actual contribution of the paper. Remove details that are previously published. More specifically,

- in the introduction, focus on the actual innovation of the work and its relation to other work.

- The detailed explanation of the surrogate model (Section 2) can be removed, providing the proper reference to the original work. Of course, a shorter summary of the model will be welcome

- Details about the different forms of (standard) Kalman filters are also not necessary, a reference is sufficient, like linear and extended KF.

2. Section 4 but wel written and clear, but I recommend the following changes:

- Sec 4.2.1 The improvement with respect to the estimation-free case does not seem to be very pronounced. Can you comment more on that. The state estimation adds significant computational complexity, which requires more significant benefits in terms of accuracy. Maybe a different simulation scenario, including changes in the wind conditions during the simulaton, can be used to better demonstrate the performance.

- Sec 4.2.2, Fig 6: please show the model output (WT power) estimation and compare to the true output. At both turbines the wind speed is estimated clearly higher than the simulated one, implying that the estimated power will also be (much!) higher.

- Fig 7: it is essential here to simulate using a realistic low frequency variations in the wind condition. Obviously, the prediction will be good when the incoming wind speed and direction does not change, since the underlying model does not change. The different KF's outperform the OL simulation in the prediction ONLY because the initial condition at the beginning of the prediction part is worse for the OL case (the KF based models have been adapted during the estimation phase, and the OL model has not). I suggest you focus in Figure 7 on the estimation part and remove the prediction part. Same holds for Figure 10.

- Sec 4.3: the performance is compared to the open-loop simulation with the correct wind velocity U_inf, while the EnKF is initialized with a different U_inf. For better comparison I recommend you compare to the OL simulation with the same initial condition. That will not only be fair, but actually also in favor of your approach.

- Fig 11. It would make more sense to focus the comparison only on the wind velocity in the wakes, rather than the whole wind field.

3. It is claied on several occations in the paper that the presented estimator is useful for performing long-term forcasting. I disagree with this statement, and if you want to convince me then you would have to demonstrate the ability of the estimator to make correct predictions in the future when the input conditions (eg ambient wind velocity) vary in time. For instance, to predict upcoming wind speed or direction changes. Obviously, this will not be possible, so I suggest that with respect to the application of the estimator you stick to feedback control. When used for MPC, I suggest using the term short-term prediction.

Minor comments:

- p.2, line 9 - remove bracket

- p.6, line 2 - abbrev ADM seems not used in the sequel, check and if so - remove. Same holds for the abbrev. UT on page 11, line 15

- p.6, eq. 4: define \phi, D and C_{T_i}ˆ' (what do you mean by variation?). Also, does the term H[] not imply that the thrust force is excerted within a circle around the turbine, rather than on the rotor plane/line?

- p. 8, bottom: notation already defined in Sec 2.4

- p. 9 bottom: why is P_{k|k-1}ˆz is not necessarily invertible, then L_k will not be full rank (or possibly even Lk=0), implying that some (or all) measurements will not contribute to the state estimation

- p.11, eq. (21): define all used notation

- p.13, eq (27) : how are the estimates \hat w_{k-1}ˆi and \hat w_{k}ˆi obtained and

updated?

- p 16, line 1: are you suggesting to use the wind vane measurements of only the upstream turbines to estimate \phi, or all turbines? Please be clear, because if you use all turbines you will be neglecting the dynamics of the propagation of the wind direction through the wind farm.

- p.18, line 14: estimation -> you mean "parameter estimation"?

- p.21 Fig 6 caption: "The freestream wind is coming in from the top of the page, and flows towards the bottom." Isn't it the other way around?

- p.22 line 3: "Dual estimation using flow measurements downstream..." - please explain the used measurements in more detail

- p22, line 4: exaplin figure 7 clearly. What's on the y axis?

- page 25, equation on bottom: bullet notation not clear

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