

Title : Lidar-based wake tracking for closed-loop wind farm control

Dear reviewer,

We really appreciate your comments and have tried to adopt and consider all of them. Please find below a point-to-point reply. Further, in the supplementary material, a latexdiff is given. (Having already considered the review of reviewer 1)

Thank you very much for your effort!

Best

Steffen on behalf of the authors.

Summary review : *The article provides a novel approach to tracking the wake center behind a wind turbine using lidar measurements, which will be of value to the wind energy community when trying to develop a closed-loop wind farm controller. The concepts discussed in the paper are well organized and overall has good flow. I was hoping to see more discussion of the controller performance at the end, but this paper is more about the wake tracking than the controller. Perhaps controller performance was discussed in Raach et al. (2014), and could be played up more in this paper to address a reader's desire to see controller performance. It would be nice to see in figures 8 and 9 a comparison to the lidar's tracking of the wake center to the actual wake center. However, defining the wake center is not easy and that is acknowledged by the authors. In practice in the field, defining the wake center is nearly impossible to do anyway as full flow field knowledge is virtually impossible.*

Thank you for your review. You are completely right, this paper covers more the estimation task and the 2016 ACC and also my current work focus on the control part. I will mention it in the beginning of the control part and in the conclusion. Figure 10 gives exactly what you asked for. You are completely right, however, when talking about the wake center definition and comparability challenge.

Page	Lines	Comment	Reply
1	3	The tracking is demonstrated... > The wake tracking is demonstrated...	Thanks
1	4	Spell out the acronym "SOWFA"	Changed.
	9-10	"The wind speed in the wake of a wind turbine..." This sentence looks to describe a wake, but seems out of place. Perhaps the wake concept can be introduced in the previous sentence "...installations are limited, the interactions between..." > "...installations are limited, the wake interactions between..." Then this sentence makes more sense.	Thanks for the suggestion. I considered it.
	11	If a wind turbine is hit... > If a wind turbine is impacted...	Thanks.

	21	...is proposed and... > ...was...	Has been rephrased.
	22	...torque actuator and steering the wind turbine to... > ...torque actuator and operating the wind turbine at...	Thank you. We adopted it.
	23	This results in a weaker... > This results in less of a...	Thanks.
	26	...Fleming et al. (2014b, a); > ...Fleming et al. (2014a, b);	Thanks. This was a strange behavior of the bibtex package
2	1	...(in seven diameter... > ...(at a seven diameter...	Thanks.
	1	...by yawing the turbine up to 40 deg. Is there a reference to back this sentence up?	Added.
	12	...a closed loop controller is In summary,... It seems there is something missing between "is" and "In	Our fault. We have corrected it.
	20	...a main problem exist. > ...there exists a main problem.	Thanks.
	22	Having averaged the flow... > After having averaged the flow...	Rephrased.
	23-24	However, taking a different method of defining the shape, the wake center position could be at a different position although the flow would be the same, see Vollmer et al. (2016).	Rephrased.
	27	Considering the task of a lidar-based wake tracking then this includes first a reference definition of the wake center and second... > The task of lidar-based wake tracking includes first, a reference definition of the wake center and second,...	Thanks. We adopted it.
	30	...a closed-loop controller which want to manipulate... > ...a closed-loop controller which look to manipulate...	We rephrased and tried to make it clearer.
3	1	...device, a lidar, and processing... > ...device, such as a lidar, and processing...	Thank you.
	10	In the following,... > In the following sections,...	Thanks.
	10-16	This should all be one paragraph	Ok

	14	The in the following described tasks present... It seems something is missing between "The" and "in"	We rephrased it.
4	3	...first a reference is needed to be defined. In this work an adaptation... > ...first a reference of the wake center is needed to be defined. In this work, an adaptation...	We removed parts and rephrased the beginning.
	7	For equation 1, can you specify the variable y in the following paragraph? I assume it is the spanwise offset.	Thank you. We missed that. But we prefer to use "lateral offset".
	9	The wake center is calculated every time step... Can you specify how far downstream the wake center is being calculated here and in figure 2?	Thanks, good point!
	12-13	The wake center clearly converges to a steady value with increasing averaging time T . This sentence implies that an increasing averaging time is better. So, just always choose an increasing averaging time is the thought process in my head when I read this. Perhaps it should be stated that there are adverse effects for choosing an increasing averaging time. I could see that an increased averaging time would be slower to adjust to a changing wind direction, and so this should be considered when choosing an averaging time to use	Very good point, we have added a sentence like you suggested.
	14	For section 3.2, the discussion here about comparing between lidar measurements and real data is a little confusing. I think this is being compared in simulation results. I think that this section should start by stating that these comparisons are being	We have added something at the beginning of section 3.

		made in simulation to help a reader to understand these comparisons.	
	18	...the used models can be used... > ...the models can be used...	Thanks.
5	10	A solution to this limitations... > A solution to these limitations...	Thanks.
	11	...applications of lidar system usage in wind energy... > ...applications of lidar systems in wind energy...	Thanks.
	12	...reconstruction methods, see Raach et al... > ...reconstruction methods, Raach et al... To be consistent with the other reference notation in this sentence.	Thanks.
6	1	In the discussion of the main wake effects, I was thinking that wake meandering should be included in this list, but perhaps that falls into the category of wake evolution. Maybe wake meandering should be its own item in the list, but I do not have a strong opinion one way or another.	Since it is not modeled in the reduced order model, we haven't mentioned it. Since the model is used for identification the meandering DOF is not necessary at the moment, but could be considered if necessary.
	8	In the discussion with equation 2, I am wondering why do you need to rotate the coordinate system? I am sure there is a reason, and perhaps you can state why.	It is just a convention to introduce different coordinate systems for wind, lidar, turbine. It gives the freedom to yaw the turbine, or consider a misaligned wind field in the reconstruction.
7	12-13	New energy is flowing from the side and above and the flow is mixed. > New energy flows in from the freestream and mixes with the wake.	Thank you, good point!
	15	In contrast to other wake models, however, ... > However, in contrast to other wake models, ...	Thanks.
8	7	...optimization of the yaw angles for a wind farm... > ...optimization of the yaw angles for a simulated wind farm...	Ok.
8	18	...non yawed... > ...non-yawed...	Thanks.

9		For the caption for figure 6, change “Non yawed” to “Non-yawed”	Done.
9	7	As depicted in Figure 3 ... > As depicted in Figure 3, ...	Thanks.
10		In figure 7, it would be nice if above each figure in the top row there was a title that specified the downstream distance of each measurement: 0.6 D, ? D, ? D, ? D, 1.4 D. All I know is 0.6 and 1.4, but the inner distances are not specified.	We have added the distances in the caption.
	2	Second, the turbine is misaligned... Could you specify how much the turbine is misaligned	It is done.
11/12		In figure 8/9, the title of the subplot “wake misalignment” is confusing. Do you mean the turbine’s yaw error over time?	Yes. I will correct.
12	5	...approximated with an delay. > ...approximated with a delay.	Thanks.