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

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Summary of article: The article presents a method for tracking a wake center from lidar measurement data to be used in real time in order to provide an input for a closed-loop wind farm controller. Wake modeling is addressed as it is necessary to take the lidar measured wind field data and transform it into useful information for tracking the wake position downstream of a wind turbine.

Review Summary: 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.

Page:	Line:	Comment:
1	3	The tracking is demonstrated… > The wake tracking is demonstrated…
1	4	Spell out the acronym "SOWFA"
1	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.
1	11	If a wind turbine is hit… > If a wind turbine is impacted…
1	21	…is proposed and… > …was…
1	22	…torque actuator and steering the wind turbine to… > …torque actuator and operating the wind turbine at…
1	23	This results in a weaker… > This results in less of a…
1	26	…Fleming et al. (2014b, a); > …Fleming et al. (2014a, b);
2	1	…(in seven diameter… > …(at a seven diameter…
2	1	…by yawing the turbine up to 40 deg. Is there a reference to back this sentence up?
2	12	…a closed loop controller is In summary,… It seems there is something missing between "is" and "In"
2	20	…a main problem exist. > …there exists a main problem.
2	22	Having averaged the flow… > After having averaged the flow…
2	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).

		> However, if a different method of defining the shape is used with the same flow, the wake center position could be found to be at a different position, see Volmer et al. (2016).
2	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,…
2	30	…a closed-loop controller which want to manipulate… > …a closed-loop controller which look to manipulate…
3	1	…device, a lidar, and processing… > …device, such as a lidar, and processing…
3	10	In the following,… > In the following sections,…
3	10 – 16	This should all be one paragraph.
3	14	The in the following described tasks present… It seems something is missing between "The" and "in"
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…
4	7	For equation 1, can you specify the variable y in the following paragraph? I assume it is the spanwise offset.
4	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?
4	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.
4	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 made in simulation to help a reader to understand these comparisons.
4	18	…the used models can be used… > …the models can be used…
5	10	A solution to this limitations… > A solution to these limitations…
5	11	…applications of lidar system usage in wind energy… > …applications of lidar systems in wind energy…
5	12	…reconstruction methods, see Raach et al… > …reconstruction methods, Raach et al… To be consistent with the other reference notation in this sentence.
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.
6	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.
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.
7	15	In contrast to other wake models, however, … > However, in contrast to other wake models, …
8	7	…optimization of the yaw angles for a wind farm… > …optimization of the yaw angles for a simulated wind farm…
8	18	…non yawed… > …non-yawed…
9		For the caption for figure 6, change "Non yawed" to "Non-yawed"
9	7	As depicted in Figure 3 … > As depicted in Figure 3, …
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.
10	2	Second, the turbine is misaligned… Could you specify how much the turbine is misaligned?
11		In figure 8, the title of the subplot "wake misalignment" is confusing. Do you mean the turbine's yaw error over time?
12		In figure 9, I have the same question about the subplot title as in figure 8.
12	5	…approximated with an delay. > …approximated with a delay.