

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

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Summary of article : The authors describe a method of identifying the wake center and a model for wind field reconstruction which is applied both on simulated and measured data to track the near wake and use it as input to a closed-loop yaw control system. The measurements are obtained with a nacelle-mounted lidar. The simulations are performed with SOWFA. A previously proposed controller is revised and proposed to be used alongside the wake tracking algorithm.

Summary review : The work seems to be innovative and of value to the scientific community, but the manuscript is extremely hard to follow because of the wording / order of statements. The writing needs to be overhauled so that it can be more accessible. Below some specific suggestions are made to improve clarity.

Page	Lines	Comment
1	8	issues in the wind farm as opposed to...? the individual turbine?
	15	or > and
	19	In relation to wind turbine control, the same two goals are valid for wind farm control > The same two goals are valid for both wind turbine and wind farm control
	20	These goals were addressed in research with different approaches unclear whether you are talking about previous research or your own, please reword it
2	1	in > at
	4-5	the barrier is not necessarily a lack of devices, but their cost, logistics, etc?
	6-8	weird sentence, I suggest rewording similar to Lidar can be a useful tool to address the measurement problem in wind farm applications, while bearing in mind the instrument limitations and the assumptions required to extract the information and exploit the lidar measurement data.
	9	It aims to enable closed-loop wake redirection
	12	incomplete sentence?
Introduction		Since you are going into so much detail and level of simplicity when you put things in context in the introduction (e.g. flow is modeled by Navier Stokes), you should also briefly explain difference between open vs closed loop control, and why focus on one vs the other. Also, introduction makes it sound like no one else has looked into this before (closed loop wake redirection), is this the case? If so that's fine otherwise you should refer to their work.
Figure 1		remove a
	20	exist > exists there isn't a > there is no
	21	which is a concept based on time averaged profiles of the wake behind a turbine.
	22	Give a time scale for these averages Having averaged the flow something like a > the language is too informal, reword something like "Averaging the flow yields a (double) Gaussian

		function for the velocity deficit profile in the horizontal and vertical directions..."
	23-24	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 > also needs rewording, suggestion something like "when different methods are used to define the shape, wake center estimates may be vary under the same flow conditions"
	24-25	Thus, there isn't a unique wake center definition. This makes a comparison difficult and needs to be considered when comparing results. Suggestion... The absence of a unique wake center definition must be considered when comparing results as it precludes direct comparisons (across different studies?).
	27-28	Considering the task of lidar-based wake tracking then this includes first a reference definition of the wake center and second an estimation method which is used to get the closest estimation of the wake center from the lidar measurement data.
	30	which want to > to
3	2-3	"estimate" verb repetition...
	5	you repeat over and over again "a redirecting" which sounds really off -- either remove "a" or change to a better noun, e.g. redirection
	7	compensates > compensates for
	8	can be > is , which is due > due
	10	first, the measurement problem is addressed. the measurement problem is addressed first.
	11-12	Keep in same paragraph!
	14	The in the following described tasks ??
4	3	As described before, first a reference is needed to be defined. As previously mentioned, it is first necessary to define a reference. (still sounds like an incomplete sentence, a reference what?)
	3-4	Can you be a bit less concise here? Unclear what the Vollmer work is. Example: The minimum wind power method proposed by Vollmer et al. (2016) is adopted here to identify the wake shape/center.....
	4	Is all the work 2D? Not yet very clear until this point
	9	which is every second > sampled at 1 Hz frequency?
	9-10	In addition to Vollmer et al. (2016) You mean in addition to using the method proposed by Vollmer?
	10	with different time constants you mean over different running window lengths? over different time intervals? averging time T?
	11-12	Therefore, a SOWFA simulation with low turbulence level and a mean wind speed of 8 m/s is used in which the flow field is sampled and every 1 s. Therefore? This is a conclusion from something? Needs rewording...ex: The results presented are for a low turbulence (TI=??) SOWFA simulation under a mean (free stream, hub height?) wind speed of 8 m/s...

Figure 2		<p>Caption is not descriptive, stand-alone and clear enough. Something like... Time evolution of wake center (meters away from hub? what is negative vs positive?) when different periods T (s) are used to average the flow during the wake center calculation.</p> <p>Why are first 100 s so different? Is this some model spin up, while the wake is still slowly developing? If so, maybe this data should not be part of the analysis, or this should be acknowledged somewhere?</p>
	16	approached > approaches
	17	can first compare to existing quantities. > can first be compared.....
	16-17	like estimation of the rotor-effective wind speed, or estimating u and v wind vector components using lidar measurements like in Schlipf et al. (2012), this whole thing should be in parenthesis to make sentence more readable (e.g., estimation of the rotor-effective wind speed, or of u and v wind vector components as in Schlipf et al. (2012))
	18	be used predict > be used to predict after line-of-sight velocities can you put (v_{los}) so that when it shows up in the next figure the reader is already familiarized with your nomenclature / symbology
Figure 3		<p>The general concept of model-based wind field reconstruction: Estimating the wind field characteristics by fitting simulated lidar measurement data ($v_{los,s}$) to the measured ones ($v_{los,m}$).</p> <p>The general concept of model-based wind field reconstruction, in which the wind field characteristics are estimated by fitting simulated lidar measurement data ($v_{los,s}$) to measurements ($v_{los,m}$).</p>
5	16	simulated lidar measurements I am not sure you should call it measurements if they are not measurements!
	19	What's the " wind field parameter"?
	20--	This whole paragraph, please rewrite, words and concepts are repeated a lot, very unclear.
6	9	horizontal rotation of the wind field you mean the wind direction? Also I'm pretty sure you mean underlying whenever you have underlying
	13	...and the subscript i represents...?
	14	component. Thus, this yields > components, yielding
Figure 5		<p>If the coordinate system follows the wind turbine reference frame, then what do negative wind speed values mean? Also, does it matter at which downstream distance this is? And is there any yaw misalignment here? Unclear</p>
7	4	the deficit is cleared over distance > the momentum deficit recovers?
	8	what is s ?
	15	what does " impulse dissipation" mean
8	1	You might want to use D instead of d , or maybe x for the downstream distance, because in equations the little d looks like a derivative, as in Eq 8 I first thought it was derivative of the dissipation. Or maybe just put a multiplication sign there, or the d outside of the fraction multiplying everything...
	19	by constant you mean steady (constant in time) ?
	7	the model parameter

		still confused that THE parameter is?
	12-13	The way you worded this sentence makes the reader think you want to make a point here. If it's just an example (which at least in this section, it is because now the section is over) then say so--for example: An example of an estimation step of the wake tracking from a measurement campaign at the alpha ventus offshore wind farm is shown in Figure 7.
Figure 7		A plot of you don't need to say this is a plot! five distances > five downstream distances is this looking down or upstream?
	15	has already shown > shows (you haven't discussed Figure 7 at all)
	17	merged to a wind field what does this mean? also use a different symbol in your 7x7, maybe \times wherever it appears in manuscript
10	1	in > at
	4	most far > furthest (wherever it appears in manuscript) the wake parameter , what is this again?
	6	positions > position there isn't a > there is no
		How did you come up with 0.1 for your dissipation?
Figure 8		Time series of model parameters for wake tracking of simulation data? missing a period
11	8	sorry what is "the filtering"? can you be more specific, I don't remember anymore at this point
12	5	an > a
Figure 9		I assume this is a mistake? I don't understand why it's same caption as above but results are different!
13		Figure 11 is talked about in text before Figure 10 so these should be swapped? Actually seems like Figure 10 never comes up?!
	6	the assumptions of a constant thrust coefficient, c_T , is made. the assumption of a constant thrust coefficient is made.
14	5	is this so obvious to the community that it doesn't need a reference?
	2	what is subscript dem?
	8	using a Smith Predictor. A Smith Predictor uses > using a Smith Predictor, which uses
	21	the sensitivity and the complementary sensitivity As someone not in controls field I don't understand this. It's weird that in some spots you get into such seemingly unnecessary descriptions of things (again, saying the flow is modeled with Navier Stokes for example) but then at other points you assume all your readers will know these concepts? If it's not too difficult, add a line explaining what these concepts mean or refer the reader to some reference. There is a lot of very controls-specific stuff throughout your paper which is fine and great since that's your main topic, but your paper will reach a much broader audience if you make it clearer and more readable to people that do wind research but focus on other aspects, and who may be interested in applying what you've done.

15	12	enable > enables
16	5-6	keep in same paragraph
	6	an > a