Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2018-62-SC1, 2018

WESD

Interactive comment

Interactive comment on "Local turbulence parameterization improves the Jensen wake model and its implementation for power optimization of an operating wind farm" *by* Thomas Duc et al.

R. Gandoin

rga@c2wind.com

Received and published: 12 October 2018

Dear authors,

Thanks for a nice paper, which I read with great interest ! I am listing some comments below, I hope some at least can be useful.

Apologies if the comments are not perfectly neat and well written. Some may just be incorrect or irrelevant, I hope you won't mind if that is the case.

Very interesting paper, much work has been put into this, well done.

All the best, Rémi Gandoin

Printer-friendly version

Discussion paper

1. Introduction

"in some cases wake effects are still persistent at significant distances downstream": maybe quantify "significant"

"maximize their own power production": this is true only for the constant TSR control region, right ?

"Two different strategies are mainly considered": in this paper ? or in general in the literature ?

"either the upwind turbines are curtailed": does this mean that the ouput power is set to a constant value, or that the power is just decreased compared to the original control settings ?

"small gains in power production are indeed possible": using the first or the second strategy, or both ?

"high variability with incoming wind conditions": - does this mean that they can have positive and negative effect on park production ? or only positive effect but with some (how much ?) variability ? - what is meant by "wind conditions" (speed, direction, temporal/spatial scale) ?

"where wind conditions are fluctuating constantly and significantly": same as above

"Very few full scale field tests have been realized to investigate this question": can you refer to these few, if there are publications available ?

"uncertainties remain high": can you specificy whether you refer to accuracy and/or precision ?

"La Sole du Moulin Vieux (SMV)": 7 x Senvion MM82/2050 ? maybe refer to Figure 1.

"and was dedicated to axial induction control strategy": what does this mean (in a few words) ?

Printer-friendly version

Discussion paper

"high level of curtailment": see my question about defining curtailment above.

"could be observed": how ?

"combined power production": you mean the sum of all WTG production ?

"part of the lost power": can this be quantified ?

"the best settings": which parameters are changing ?

"as a function of wind speed and wind direction": measured by the nacelle anemometry ?

"Jensen model": reference ?

"local measurement of turbulence intensity": how ?

"The resulting wake deficit appears to be more consistent with observed data": can you quantify ?

"the original model": you mean the k-parameter value of 0.075 as in http://orbit.dtu.dk/fedora/objects/orbit:66401/datastreams/file_f7da8eb2-e49c-4dc9-9ee5-72846f40ef34/content ?

"Figure 1. Layout of SMV wind farm and location of wind measurement devices. Inter distances between the wind turbines are expressed in rotor diameters": please specify that D=82m. Could we worth showing a bigger area, maybe {49.816789°;2.753916°} to {49.868842°;2.843664°};

"red arrows indicate the main wind direction ": maybe add that these are °N. How wide are the wind-directional bins ? How is the wind direction defined ?

Section 2

"SCADA data": 10-minute ?

Section 3.1

"where U0 is the incoming wind speed at the upstream wind turbine, Uw the velocity in the wake and R the radius of the upstream rotor.2": ,and C_T the Thrust Coefficient corresponding to U0.

"its inaccuracy": which one ?

"local turbulence intensity": see my question above regarding how you measure this.

Section 3.2

General comments: - you may also want to refer to Section 2.4 of (Lissaman, 1976): https://drive.google.com/drive/folders/1tI2p3W1qRj2GsYkt6RI6VITJMpQh7PMc.
- if the wake expansion factor changes within the wind farm, could this be visible on high-resolution wake measurements reported in http://iopscience.iop.org/article/10.1088/1742-6596/1037/7/072008/pdf ? If k=0.9*TI_WTG then, based on Figure 7, the first wake "cone" should expand with an larger angle than the one for the rows downstream, have I understood correctly ?

"This empirical constant is supposed to vary from one wind farm to another": reference ?

"or vice versa": why is that ?

Section 3.3

"Four months of second-wise SCADA data": you mean 1-Hz ?

"Figure 3": - could you use a function using "density scatter plots" in Matlab and plot the mean and median binned values as well? - the plot NWS vs Met mast shows less scatter than the plot NWS vs LiDAR: could you also show Met mast vs LiDAR (there maybe 10-minute time offset) ?

Section 4.1

Ggeneral comments: - have you considered using the M2 mast dataset measurements for Horns Rev 1? - have you considered a wider wind directional bin ? As I remember, Gaumond showed that using narrow bins, led to bias in the validation, since the model is "steady state" and will consider the turbines always aligned. A workaround is to run a model simulation every 0.5° and then weight the results using a gaussian distribution of the wind directions.

"modified Jensen model": maybe only semantics here, but it seems to me that you are only tuning the input k parameter and not changing the model.

"Region II": can you highlight this region in Figure 5 and Figure 2 ?

"Figure 6": - could you state that "TI" is the TI measured using the Nacelle Anemometer (and not the ambient TI) ? - could you add a curve which uses k_w=0.4TI_ambient, as suggested in the Sexbierum paper ? - the TI value of 12 % for the first WTG at HR1 seem large, for offshore conditions - see typical values in https://pcwg.org/proceedings/2014-10-06/06-Turbulence-Intensity-measmnts-offshore-4-PC-verification-wind-res-assmt-R-RiveraLamatA-D-Pollack-Dong.pptx - can you show a histogram of the corresponding wind speeds ? - for (b): do you see a difference between nightime and daytime ?

"was clearly overestimating the power deficit for the wind farm of Horns Rev-I, as it 10 gives narrower wake growth within the wind farm": it depends actually, see http://www.eera-dtoc.eu/wp-content/uploads/files/Nygaard_Systematic_quantification_of_wake_model_uncertainty_offshore2015presentation.pdf. The stability conditions may well differ significantly between the different studies, for the same wind farm, since people use different datasets for model validation.

"Figure 7": - the value of TI for the first WTG at HR1 is 8 %, is was 12% in Figure 6 - can you explain why this is ? - same as for Figure 6: could you state that "TI" is the TI measured using the Nacelle Anemometer (and not the ambient TI) ? - same as for Figure 6: could you add a curve which uses k_w=0.4TI_ambient, as suggested in the

Sexbierum paper ?

Section 5.1

About eq. (5): once the WTG is curtailed, will this relationship hold ? See for instance Figure 1 of http://iopscience.iop.org/article/10.1088/1742-6596/1037/3/032039/pdf (I don't have the answer).

Section 5.2

"The reason for this increase was related the presence of the motorway": could it be the large warehouse located at 330°, 2km upstream of the mast ? Could you make a plot on nighttime and on daytime ?

Section 5.3

"as the upstream wind turbine is down-regulated, the wake added TI emitted by this turbine is reduced": because it is a function of CT, and CT is reduced ? The TI_added is also a function of the downstream distance, see chap 3 of http://orbit.dtu.dk/fedora/objects/orbit:79899/datastreams/file_269c3f19-0001-4e41-b754-b5b322a826cb/content.

Table 1: could you also show the relative power values, for a given wind speed bin (for instance 7 m/s) ?

Section 5.4.1

"It is observed that the maximum gain represents an increase of about 2.5% and is found at 7 m/s when SMV6 is curtailed by 12% (cP decreases from 0.46 to 0.405)":as I understand, in this situation, you reduce C_p by x%, and derive a new C_t using eq. (5). Then, you choose a value of k using eq. (7). Can you then also plot these new and old values of C_t and k, that are used the calculation, in Figure 12 ? Or provide a worked-out example ? It may help the reader understand what goes on in the calculation.

"very stable incoming wind conditions": you mean stable atmosphere ?

Interactive comment on Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2018-62, 2018.

Printer-friendly version

Discussion paper