

Interactive comment on “An alternative form of the super-Gaussian wind turbine wake model” by Frédéric Blondel and Marie Cathelain

Marijn Floris van Dooren (Referee)

marijn.vandooren@uni-oldenburg.de

Received and published: 26 March 2020

This paper presents a clear and well documented analysis of a super-Gaussian model for describing wind turbine wakes, especially trying to improve the accuracy w.r.t. the standard single-Gaussian wake model in the near wake. I think the paper is well written and feels very mature. However, there are still some weak spots that could be improved. Therefore I suggest a minor revision.

General comments:

- The paper highlights the differences between the super-Gaussian and single-Gaussian wake shape very well. However, the paper does not address another common way to describe especially the near wake behavior, which is the double-Gaussian shape. Recent examples on this are:
<https://doi.org/10.5194/wes-5-237-2020>
<https://doi.org/10.1088/1742-6596/753/3/032039>
It would be appropriate if the authors also mentioned this model and include a comparison to this particular approach in their work. For example in Figure 2 the double-Gaussian wake shape can be recognized for the actuator disk wake.

- Since the paper puts a clear emphasis on defining $n(x)$ as the n th order of a variable super-Gaussian shape, it would be very interesting to have a visualization of $n(x)$ for one or more cases.
- You conclude that the highlighted cases show a good agreement between the model and the measurements. I agree, you clearly demonstrate that your model approximates the wake shape better than the single-Gaussian does it. However, in most cases there is still quite a large error remaining. The conclusion on the performance might be formulated in a slightly more critical way.

Specific comments:

- P4, L83: The thrust coefficient is described as manufacturer data. While I agree that it is a design parameter, I suggest to elaborate more on the physical meaning of it and whether you consider it as a constant or a variable in your analysis.
- P4, L97: You state that 'an unknown variable, the order of the super-Gaussian n appears'. I would phrase it differently, since n was already introduced on P2. For the reader it is not unknown anymore.
- P7, L170: I assume you use a fit of Eq. (9) to determine the parameters as, b_s and c_s ? I do not understand how the standard deviation can be omitted in this process. Could you elaborate on this? Also it would be nice to have some

more information about the quality of the fit, maybe addressing the residuals or visualizing the fit.

- P7, L172: Related to the previous comment, how big was the data set that Niayifar and Porté-Agel (2015) used to determine their set of parameters? Maybe this can also (partly) explain the differences.

Technical corrections:

- Because there is only one author affiliation, the footnote notation using the number 1 is not necessary.
- P1, L3: Consider replacing 'made on' with 'of'.
- P1, L16/23/24: Consider replacing 'inter-distance' with 'separation distance'.
- P2, L26: I recommend to change 'two shortcomings, that are actually closely related, need to be alleviated' to 'two closely related shortcomings have to be alleviated'.
- P2, L31: Consider replacing 'evolves' with 'evolve', since the subject (wake velocity profiles) is plural.
- P6, L135: Consider replacing 'Minimizing numerically' with 'Numerically minimizing'.
- P6, L139: Consider replacing 'follows more or less' with 'closely resembles'.
- P6, L145; Consider replacing 'solution' with 'a solution'.
- P11, L230: Consider replacing 'inter-distance' with 'separation distance'.
- P13, L275: The brackets around 'A2' are missing.

C3

Interactive comment on Wind Energ. Sci. Discuss., <https://doi.org/10.5194/wes-2019-99>, 2020.