Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2020-6-RC2, 2020

WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Validation and accommodation of vortex wake codes for wind turbine design load calculations" *by* Koen Boorsma et al.

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Received and published: 12 March 2020

The paper presents a comparison of different classes of codes, evaluate differences in fatigue loads, suggests potential reasons for the differences observed, and present recommendations to use vortex wake models for some DLC loads cases. The study is thorough and convincing.

Here are my general comments:

- Shed vorticity is suggested as an explanation for the differences. Time constants of the dynamic stall and dynamic wake models are also likely to be a source of the "axial"

induction filtering observed. I would actually think, the dynamic wake model might be the main source of error, since as you mentioned it is tuned to "cylindrical" wakes. You can investigate the effect of the time constants of these models on the axial induction to see if you can reach amplitudes similar to the ones observed for the vortex wake codes.

- I would recommend to make a distinction between "vortex wake models" and "vortex methods" early on in the paper, or at least mention that what is meant by "vortex wake model" in the paper is low-order vortex filament methods. Vortex methods, in general, falls in the realm of CFD, and can be of the same order of accuracy as "traditional velocity-pressure CFD".

- I'm not sure I see the need to use the term "numerical wind tunnel", verification against "CFD simulations" seem more appropriate. It could be erroneously assumed that a "numerical wind tunnel" models walls, turbulence grid, etc.

- The presentation of the different codes are relevant and provide the appropriate details, yet I would recommend removing the mention of features that are not used in this study to avoid confusion. A table providing the differences in features (e.g. dynamic stall, high-thrust corrections, discretization, regularization parameters, viscous models, etc.) used by each code-class (BEM/Vortex) could be relevant as an introduction/conclusion of the second section.

- Some of the figures can be improved for readability, and consistency (underscore are sometimes present, and units are not always present on the y-axis, but mentioned on the x axis). Since the study present differences between BEM and Vortex methods, it might be worth distinguishing between these two classes of codes in the figures. Even if a consistent color scheme has been used throughout the paper, having a way to clearly see which class of code is used would help the reader (with dashed lines or markers maybe). In general, I would think the explanations in the figure captions could be slightly extended.

- Last, I believe any attempt to shorten the length of the paper would be beneficial.

I'll be happy to review a revised version of this manuscript.

Good luck for the remaining work,

Emmanuel

Here are my specific comments:

l78-84: Reporting the distances in diameter would be valuable.

l108: "dimensional form instead of nd factors": This is probably not as relevant as the form of the equations itself, I don't think it's needed to mention this.

l121: The term Phatas is used in the text whereas PhatasSV is used in the figure. Using one of the two terms throughout the document would avoid confusion.

l129-134: Since different features are listed here, it is not clear which ones will be used. I'd recommend to only mention the ones that are used in this study and provide a link to a documentation for more models.

l140: Can you discuss the regularization/"viscous-core" model used for the bound circulation and for the wake: which model is used, how the regularization parameter is defined, does it include a "diffusion" model?

l145: Can you mention the typical number of filaments in the wake?

l159: Maybe "blade averaged induction" need to be reformulated since it seems to apply to the wake.

l250: It might not be obvious what "fixed" stands for (it's mentioned on the next line).

l251-255: From figure 4a, it appears that the axial induction from vortex wake codes are significantly larger than the ones from the BEM codes. Can you expand your justification for the fatigue loads to be lower in this case? I would have expected the angle of attack fluctuations to be larger and the loads higher as well, but I might have

missed something.

Figure 1: Could you provide the tangential force and C_T as well for all figures? The normal force is usually well captured. Depending on how these other component vary with the operating condition, it might not be necessary to show the radial distribution for the 4 wind speeds, 2 seem to be sufficient (at least looking at Fn).

Figure 1: Even if the axial induction is not present in CFD, it will be valuable to show this variable for the lifting-line codes since this is the core variable here (the rest of the angle of attack is purely defined by the free stream and the rotational speed).

Figure 2: It would be relevant to show differences in mean as well as differences in amplitude.

Figure 4, 5: the caption should preferably mention what is meant by FIXED and BSV, BL_sector

l299: "structural" might be confusing here.

l346: the tip-loss factor has also been ignored

l560: Could you mention some of the results from the tower loads?

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