Reply to comments by Reviewer Nr. 1

Giorgia Guma on behalf of the authors
IAG, University of Stuttgart

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The authors would like to thank the reviewer for his/her efforts and valuable comments in this second process of review. They are very much appreciated and incorporated into the revised paper.

In the present document the comments given by the 1st reviewer are addressed consecutively. The following formatting is chosen:

- The reviewer comments are marked in blue and italic.
- The reply by the authors is in black color
- A marked-up manuscript is added. Changed section with regard to the comments by reviewer 1 are marked in yellow.

General comments

1. "*A motivation for using CFD is given based on earlier found shortcomings of the BEM method. Still, would the main conclusion (influence of turbulence on fatigue loads dominates over flexibility) not also be obtainable using a BEM code? In other words I do see the added value in CFD for getting absolute values correct, but I question its additional value over BEM here in quantifying differences between computational settings such as flexibility. Perhaps the added value of this work lies more in validating the set-up of this detailed FSI model, allowing it to be used in applications where its significance is more clear?*"

Thank you for your comment. Yes you are right, a qualitative conclusion on the effects on the fatigue loading could have been done basing only on BEM. On the other hand, we think it was necessary to generate reference solutions, taking into account all physical effects together with a correct development of the turbulent structures in the flow field, to study the impact of the different interactions on unsteady loads. The scope of the paper was actually not the comparison between CFD and BEM, which calculations have been added under reviewer's suggestion, but we appreciated the proposal and decided to generate a model and include it. Of course we have now, additionally, a validated detailed FSI model that we also use for acoustic calculations (for example low frequency noise studies and trailing edge noise studies in IEA Task 39 and 29), where BEM cannot be used, but this is now out-of-topic. We revised and elaborated the conclusions according to your comment adding more aspects of the CFD-BEM comparison as you can see in **R1:G1** (page 22, line 377).

2. "*A lot of observations are given in the text but often I am missing the main storyline and therefore the paper becomes difficult to follow, reducing its impact. A clear focus would improve the paper rather than discussing the results of a large number of different simulations.*"

Thank you for your observation. We agree that there are a lot of results given to separate the effects. We added therefore paragraph to the introduction in **R1:G2** (page 2, line 42) describing the objectives and the procedure for clarification.

3. "*Captions do not always clearly indicate which operational condition (6.1, 9, 13m/s) or code (BEM/CFD) is used, which reduces readability.*"

Thank you for your comment, captions have been changed figures 6,7,8,10,11,12,13,16,17,19,21 and 22 following your suggestion.

Specific comments

1. "*Line 185 is it not Hendriks as mentioned in the reference?*"

Thank you for noticing it, we changed it in **R1:S1** (page 9, line 192).

2. "*Fig. 9 Color coding BEM in agreement with CFD (fig. 7)?*"

Now that we changed the captions according to your comment, we changed the color coding to be in agreement between CFD and BEM as you can see for figure 9 (in agreement with figure 7) and 14 (in agreement with figure 11).

3. "*Fig. 9 Enormous tower effect in BEM, are we sure the input is correct? If not, what is the cause for this difference? Has this been oberved in previous literature? Or can you validate against the measurements of the DANAERO database?*"

Thank you for your comment. You are right, the tower effect computed is really strong. Comparing the BEM results in time with the measurements (in order to see the tower effect) is not really feasible because those have always been made under turbulent inflow conditions. This leads to high difficulties in recognizing the tower effect. It is also to be noticed that the DANAERO rotor features a prebend but no cone angle, that is usually used to avoid a large tower effect. AeroDyn v13 (the one coupled to SIMPACK) bases the calculation of the tower effect on the work of Bak ([Bak et al (2001)]) using a potential flow solution around a cylinder together with a tower dam model. The input for the BEM tower model bases on geometric properties (taken from the structural model, and therefore consistent), and a series of "Re vs Cd" properties. Those are rarely available when creating a tower model and in lack of this information, as it has been done also in other projects and suggested by Nrel, values have been taken from [Roshko, Anatol (1961)]. We also conducted calculations where we changed those to the standard values for a cylinder (with $c_D = 0.6$) to test its influence and almost nothing changed. In summary, Aerodynv13 does not allow to really influence the way the tower effect is calculated, altough additional options are available in Aerodynv15, that could not be tested with SIMPACK. It needs also to be noticed that this drop of $20-24\%$ results from the the consideration of a single blade. When the total rotor moment is then taken into account, the drop gets reduced to just a third of it, that is a value also observed for example in [Fu et al (2018)].

References

[Roshko, Anatol (1961)] Roshko, A.; Experiments on the flow past a circular cylinder at very high Reynolds number.; Journal of Fluid Mechanics, 10 (3). pp. 345-356. ISSN 0022-1120; 1961;

[Bak et al (2001)] Bak, C.; Aagaard Madsen, H.; Johansen, J. 2001.; Influence from blade-tower interaction on fatigue loads and dynamics (poster).; Wind energy for the new millennium.

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[Fu et al (2018)] Fu, L., Wei, Y. D., Fang, S., Tian, G., Zhou, X. J.; A wind energy generation replication method with wind shear and tower shadow effects; Advances in mechanical engineering, 10(3), 1687814018759216; 2018;