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Interactive comment

Interactive comment on "Methodology for the engineering calculation of flaps on Wind Turbines using BEM codes" *by* Maria Aparicio-Sanchez et al.

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Thank you very much for your comments; they are very useful for the improvement of the publication.

I agree with most of your comments, and we will include the modifications in the final version of the paper.

- Eq (1) contains the X and Y functions that are not specified. *The deficiency functions are based on the thin airfoil theory and the specific values of the parameters are similar to the unsteady calculation observed in Aerodyn14*

- In eq (2) “alpha” is used as angle of attack while in Eq(3) the angle of attack changes into an effective angle of attack. *We will modify the notation in order to clarify that.*
- Also in Eq (3) the fraction appearing in the 2nd term is not specified. *We will introduce the description of this value.*
- Finally why should Ct be proportional to Cn? *This is the original formulation of Aerodyn14 (based on Beddoes-Leishman), and it has been modified only to take into account the flaps. The same modification has been applied to Aerodyn15, where the Ct is not proportional to Cn.*
- The semi-empirical delay mentioned in connection to Cm is also not specified. *We have not included numerical values because we would like to extend the study, before setting a fixed value. Currently, we use a factor of 0.2, which was obtained in a parametric study. This formulation of this effective flap angle will be introduced in the paper.*
- A core radius is mentioned in connection to Eq (7) but again not specified. *We have not included a usual vortex core model. We have limited the region where the vortex presents effect in order to avoid the unrealistic increase in the induced velocity close to the vortex. Inside the core region the effect is approximated by a linear distribution (tangent at the core distance, figure attached). This model has been selected after the comparison of different tests with respect to CFD results. The idea of the paper was to explain the methodology, not the specific numbers used in the cases because the validation and verification is still limited. The core in this case was the chord of the blade at that section, but again, we would like to extend the study to a wider range of cases.*
- The passage from Eq(9) to Eq(10) seems to assume that V is approximately equal to the local rotational speed

- With respect to the validation tests presented in Section 3, there is no reference to the numerical parameters and input that were used nor any discussion on eventual calibrations that were applied. Besides the time step, discussion is needed on how X and Y were defined and how the core size affects the predictions in the rotating cases. Also of significance is to know how many polars were used and how they were obtained. *The original idea of the paper was to show the methodology implemented in the code, beyond the specific numerical approaches. Most of the parameters were applied in order to be consistent with the original code FAST (i.e. the deficiency functions). Regarding the core size and the core model, we have used a new approach, and we will introduce this information in the paper.*

- The agreement shown in Figs 4 5 is good while that obtained in Figs 6 7 is less good. One clear difference between the two cases concerns the Re number. The other concerns the airfoil shape. Could any of the two explain the difference in the quality of the predictions? *The main difference is the airfoil shape.*

- It would be useful to add comparisons for the drag coefficient if measured data are available. Such a comparison would eventually explain the differences obtained in the Ct predictions shown at the end of the section. *We are still working on that, but we have no comparisons yet. For the moment, the drag seems to be very sensitive to the polars and the methods developed and the approach needs to be improved.*

- Concerning Figs 8 9, a) How was the angle of attack measured? *The angle of attack is controlled by an actuator in the wind tunnel. the angle of attack is set by a servo motor, mounted below the wing outside of the wind tunnel.* b) The predicted angle of attack does not show any hysteresis. Is there an explanation for this? *It is the input , but we have corrected these cases, in order to have the same angle of attacks and flap angles.* c) the captions of the figures do not agree with their Content. *we have corrected the mistake.*

- In Figs 10-13, the predictions do not show clear convergence to a periodic solution. Is there an explanation to that? *This was a problem with the wind input file, the convergence will be correct in the revision of the paper, and the loops now are clear. The conclusions do not change.*

- In the rotating cases, in addition to the effect of the core size, it would be useful to know the density of the elements that were used and how the transition zone was treated. In the model as presented, the flap corresponds to a discontinuity in its geometry while in the CFD simulations there is a smooth transition. It seems that the core radius introduces some smoothening. However, a similar effect may have been obtained when interpolating the polars along the span direction. *It is clear that the core radius presents a smooth transition, similar to CFD. However, the distribution of tangential forces is not smooth for any of them, so I think that the interpolation of the polars would not lead to the same result.*

- The changes in Cnand Ct are presented. I assume that they all refer to the difference with respect to the case without flap deflection. *Yes* Do the absolute values compare similarly? This is important in view of applying the particular modelling in aeroelastic simulations. *The absolute values present small deviations. The increment has been included because the analysis is clearer using this comparison.*

Other comments:

- Is there a reference to the measurements used in the second experiment? *Currently there is no reference of this campaign of experiments.*

- In the rotating cases, results from two CFD codes and one Vortex are used.

Please add the relevant references. Also, specify the wind speed in both cases. *This is going to be updated in the revision.*

- The use of language in the text may be improved. *We will try to improve it.*

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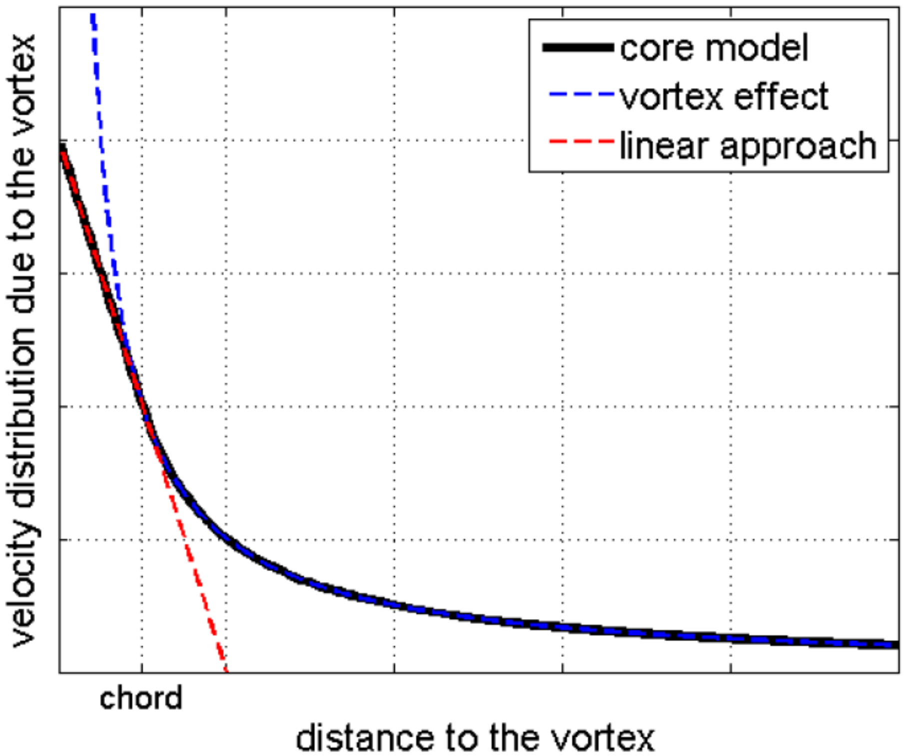

Fig. 1.

Interactive comment

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Discussion paper