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Interactive comment on "Flow angle measurement of a yawed turbine and comparison to models" *by* Tyler Gallant and David A. Johnson

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Thank you for the careful and detailed review of our experimental study.

The general subject of a wind turbine in yaw is significant and a state-of-the-art review would encompass more than what would be required to introduce these experimental measurements. The literature that has been reviewed is specific and of recent publication. Updates to the literature review are always possible if they address the specifics of the experiments detailed here.

Space was dedicated to the description of the Petersen et al. paper to properly explain the method used later in the paper to assess the upstream wind field using angle of attack measurements. It was felt that this was an exciting addition to the paper, as it both demonstrates the potential of this method as well as helps to explain and quantify

variations in the upstream flow stream, as evident in the angle of attack vs. azimuthal position figures.

The authors agree that the description of the Morote model is brief and was limited due to space constraints in the paper. However, if this limited the clarity of the explanation, the background given can be expanded to better explain the model.

It is actually not stated that the Morote model is more accurate, only that it is more recent. Due to the recent publication, the author's decided to focus the paper on this one comparison. The angle of attack was also completely modeled using the Burton et al. method and compared to experimental data, but this was left out due to space limitations.

The paper could be edited to add a background review of the Burton et al. methodology and the resulting model predictions. The model results are in close agreement with each other throughout the test conditions considered. This is an experimental study with some modeling to show the results.

In the review comments, there is considerable discussion of the model results and modeling in general. The main focus of the experimental submission (Title: Flow angle measurement...) was to detail the experimental methods (onboard instrumentation, 3D printed blade etc) and uniqueness of the facility.

Specific comments

Page 2, Line 28-29 Authors Maeda and Kawabuchi refer to the angle alpha as the "angle-of-attack," though no acknowledgement was given in the publication of a conversion from LFA to angle of attack (can not comment if it was done).

Page 3, Line 13-15 This statement can be revised for clarity. Previous research has shown that reasonable results for the airfoil performance (essentially 2D airfoil data) can be obtained from fully 3D rotating wind turbine blades using multi-hole probes.

Page 4, Line 5-6 This sentence can be phrased more clearly. It is referring to the

subtraction of the tangential velocity vector caused by the rotation of the wind from the relative wind velocity in the velocity triangle. In other words, subtracting omega*r from W to get Uinf.

Page 5, Line 5 This can be reworded or clarified before the final edit.

Page 5, Line 17 The difference between the parameters is that a0 is the induction factor for axial flow, and can vary throughout the rotation with azimuthal position. In contrast, aa0 is averaged throughout all azimuthal positions. The induction factors were calculated using the PROPID input code that was used to design the wind turbine blade.

Page 5, Line 25 Yes, that is exactly correct. According to the Morote paper, the interference functions are only valid at specific azimuthal positions and must be corrected using the phase shift. This explanation can be clarified.

Page 6, Line 6 Good point. This symbol was only introduced to maintain consistency with the Morote paper, in which it is also introduced.

Page 6, Line 6 Yes, according to the Morote model, Equation 8 is always used to calculate the geometric angle of attack. The induction correction factors account for the variation in yaw angle. This can be clarified before the final edit.

Page 8, Line 6-7 These values can be added to the final version of the paper if space allows.

Page 8, Line 8 The induction values calculated in using PROPID and presented in Table 2 were used as a0 and aa0 inputs to the Morote model. The assumption of a0 = aa0 was considered appropriate given the expected uniform flow field in the small-scale measurements. The values were calculated using PROPID using the input code originally used to design the blades. The calculation itself was done iteratively following the BEM method. These points can be clarified in the final edit.

Page 8, Line 12-13 The paper doesn't state that we used a different approach than

Schepers and van Rooij (2008) or Shen et al. (2009). We followed their approach and similarly used the Biot Savart law to convert from the LFA to angle of attack.

Page 9, Line 1 The non-uniformity is depicted in Figure 12 on Page 15, in which the Petersen method has been used to calculate the upstream flow velocity as a function of azimuthal position. A reference to this plot can be made earlier to highlight the influence of the non-uniformity on the flow field.

Page 11, Line 1-2 This can be added in an additional figure if space allows.

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