Review on: Validation of aeroelastic dynamic model of Active Trailing Edge Flap system tested on a 4.3 MW wind turbine

General:

The presented work is outstanding in terms of experimental and numerical effort. However, I suggest some measures to streamline the paper. In my point of view, the motivation should be clearer, what the goals of the first and second measurement campaign are. The way it is presented now, appears rather as a technical report than a research paper.

Furthermore, I suggest only one section on experimental setup and one section on numerical setup. In the current version of the manuscript there are multiple locations where each of the aforementioned are described.

Furthermore, a clear motivation of the purpose of the flaps on a wind turbine is missing. Do the authors aim at load control employing flaps? What kind of loads? Or power control?

Furthermore, as this is a retrofit flap, do the researchers see this also as a purpose for future application? Or is an application within the design process of new turbines planned?

Moreover, a clear statement on the limitations of the flap properties is missing: What is the frequency bandwidth of the current flap? Can the flap be driven to continuous angles, or is it an on / off system?

Identified Model: As I understand it, the model was tuned at one wind speed? Is an operating point dependent model necessary? So, a gain scheduled type of model? Also, a dependency on azimuthal angle was stated. Is the azimuthal angle part of the identified model? Why did the authors not employ state-of-the-art system identification methods? Why were only step changes employed for model identification and not sinusoidal motions?

The section on the NW model is interesting but it is not clear, if this model was used for the validation in the paper. If this model was used, why is it not stated in the numerical setup section? If it wasn't used, I m not sure if the presented validation is beneficial for the current paper.

Regarding the uniqueness of the experimental setup: Did the authors encounter any differences in flap effectiveness due to erosion on the blades / actuator wear? As the authors state, this is the only known example of a flap that was tested for a long time in the field, so it would be interesting if the authors could elaborate on the degradation (if there is) of the flap / measurement results over the long measurement time.

Finally, I highly recommend a revision of English language.

Furthermore, I provide some suggestions / questions with line numbers:

Detailed Recommendations:

1) Title: Are the capital letters of 'Active Trailing Edge Flap' intentional? All other beginning letters are lower case.
2) Abstract: I recommend to avoid all abbreviations in the abstract.
3) Page1 Line2 (P1L2): There is little research on flaps for AEP increase. Is this statement necessary here? Is it a purpose of this study?
4) Abstract: I recommend present tense.
5) P1L14/15: …flap … flap… - reword
6) P2L35: activation vs. actuation
7) P2L51: as 6)
8) P3L70: specific section means specific blade section?
9) P3L92: GPS time means UTC ?
10) Generally, on Section 2: This is an impressive and unique setup. However, can the error of the measurement technique be estimated? Can the flap deflect in both directions (towards suction and pressure side)? What is the frequency bandwidth of the flap? How is the pitot tube measurement corrected for the induction of the blade? Were any changes of BRB observed on the blades that were not equipped with the flap?
11) P4Figure 1: This left photo suggests multiple flaps. Does the setup consist of one or multiple flaps? Are the gaps between the flaps due the deformation of the blade during operation?
12) P5 L111: max = maximum?
13) P5L120 controller signal = flap setpoint?
14) P5L128 what is meant by a '21% thickness flap profile'? This sentence is hard to understand.
15) P5L133 'instead' does not align with previous sentence. This section should be reworked. I miss an introductory sentence: Profile with xy% thickness, xy%thickness were equipped with ATEFs on the blade. Therefore, …
16) P6L150 how is the lift derived from the flyboard measurements? Pressure Integration of the pressure belt? Are 15 pressure taps sufficient to estimate the local lift?
17) P7165 How is the video synchronized with the valve commands? A simple encoder could not be used as a pneumatic flap is employed?
18) P7166 So the flap can be actuated in three positions? not, half and fully deflected? In my point of view, this should be stated in section 2
19) P7L172 Was a model identified each state (normal power operation and idling?)?
20) P7L175 Can you clarify what is meant by 'independent of the actual activation pressure'? The pressure to drive the flap is not considered in the model? As only a model is identified from flap setpoint to Cl ?
21) P7L182 What exactly is the 'signal of the flap controller' ? The flap setpoint?
22) P8L183 So the valve transient is ignored? Where is the pressure measured for the 'pressure channel' signal? Is the valve located in the hub or close to the flap?
23) P8 Figure 4 – 3 seconds rise time for the flap deflection seems very large. Which load cases target the authors?
24) P185L188 This model is only valid for normal power production? Is there a identified model for idling cases? How do they compare? Maybe, this could be added to the paper.
25) P8L189 'on a blade section' suggest only the pitot tube / pressure belt were used for validation. In this section the BRB is also analyzed. I suggest a change of title of this section.
26) P8L191 – How was the selected wind speed ensured during a 3 hour test in the field?

27) P8L195 – Measurements – I suggest to move this section to section 2. Thereby, one single section on measurement setup helps to streamline the paper.

28) L200 – A sampling rate of 100 Hz is fairly low. How did the authors ensure that there aren't any aliasing effects?

29) L216 This sentence is hard to understand. What is a 'full middle-pressure activation' ? I understand one cycle comprises 60s activation and 60s deactivation? How does this lead to 90s 'full activation and deactivation cycles'?

30) L222 FA angle = Flap actuation angle or azimuth angle? Please clarify the abbreviation

31) L224 So, the input to the simulation is not the met mast data? Is there a reason for this? Is it possible to input the experimental data from measurements to the simulations? How would this affect the results?

32) L225 As 29), is there a copy paste error in L216 for the times of activation / deactivation?

33) L234 The challenge of system identification with present periodic frequency components that origin from disturbances on the output signals is well known. Van Wingerden (https://ieeexplore.ieee.org/document/5497118) solved this by dividing input from actuators and input from disturbances at known frequencies. Is there a reason why the authors did not choose a system identification methodology that accounts for these different input types?

34) L252 Did the authors consider notch filters on the multiple p frequencies?

35) L260 What is a flap actuation azimuthal angle?

36) L265 Why is Cl decreasing before activation?

37) L267 What is the statement of this sentence? That the averaged CL transient is smoother than the measurements? Shouldn't this be expected?

38) L268 If there is a 5.3.1 where is 5.3.2?

39) Comparing 5c (rise time 1.5s for Cl) and 6c (rise time ~1 s for MBR) is seems that the blade root bending reacts faster than the local lift. Can the authors confirm this observation? Can it be physically explained?

40) 313 max difference of 0.1 – Which unit is this value? Is it normalized?

41) 359 What does 'with the simulation anticipating the measurement of 0.2s.' mean? Can you please clarify?

42) Figure 9 – There are multiple red and orange lines in this plot which makes this graph hard to read.

43) 384 – the yaw direction varied by 1 rpm? What does this mean?

44) Figure 10a) is the xlabel cropped?

45) Figure 12 – the y label should rather be called normalized blade root bending moment

46) L449 What is meant by 'being fully dynamic' ?

47) L459 'Regarding'

48) Section 7 – Were the previously presented results calculated with NW model or without? If this model is more accurate, why is the model without NW model employed at all?

49) L491 Which angle? Can you please clarify?

50) L515 'their' type o ?