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# *Interactive comment on* "Study on Multi-Objective Optimization Design and Passive Control of Wind Turbine Airfoil" *by* Yong Peng et al.

**Anonymous Referee #2**

Received and published: 20 September 2019

[General comments]

Dear Peng et al.

Thank you for submitting the manuscript.

Overall, the work is based on a functioning numerical framework. The attempt to automate the design process with a tool-chain using high-fidelity models is interesting, as is the use of multipoint optimization to obtain more robust designs. However, further work is needed.

Specifically, the numerical optimization framework including geometric modelling capabilities, automatic meshing and CFD flow evaluation is interesting, but more details on the flow solution and underlying optimization algorithm should be provided. Also,



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Discussion paper

an assessment of how well the optimization problem has been solved, is needed. Finally, the 'story' behind the setup is not easily understood, i.e. why are we interested in thickening the TE on a rather thin airfoil (18 %)? Blunt TE is typical for the inner part of the blade, but an 18% airfoil clearly pertains to the outer part of the blade. Thus, the overall story seems hard to view in a prism of wind energy.

Based on the above, I suggest a rejection, since a much more thorough presentation of the framework and assessment of the optimization is warranted. In case, the authors would be interested in some specific comments I still include these below in the hope, that they may be of use for the authors.

[Specific comments]

p. 1 - concerning: Overall setup

The paper presents a multipoint airfoil optimization followed by yet another optimization where the TE thickness is increased. As mentioned in the introduction (p. 2) structural considerations often result in blunt trailing edges. This is true, but these are often found on the inner third of a wind turbine blades. Yet, the starting point of the optimization is an 18 % thick NACA airfoil which is not thick enough to be relevant for the inner third of a wind turbine blade. Indeed, airfoils so thin are on the contrary found on the outer part of the blade. Thus, the overall setup could be more coherent.

p. 2 - concerning: Passive control

The term also is present in the title, but save for perhaps (p. 3, l. 5) we never hear of this term again in the manuscript. It should have a much more prominent role in the manuscript.

p. 6 - concerning: Numerical settings

Why is 29.21 m/s chosen? Perhaps because the chord is unity (please state length of chord) and a Reynolds number of 2 M is desired? Still, as thin airfoils as 18% are likely found on the outer part of a blade. Here, the speed is more likely to be in the ballpark of 80 m/s. The chosen settings should be explained further.

p. 7 - concerning: AOA: 0->17 degrees

What is the motivation for choosing this exact range of AoAs on p. 7? Given that most airfoils operate close to 6 deg AOA especially the 17 deg AOA seems to warrant further motivation.

p. 7 - concerning: Final design variables from optimization seen in Tab. 2

Q1: Why are there 5 significant digits when only 3 significant digits are used in Tab. 1? Q2: I suspect all b_{2,l} and 2 of the b_{2,l} final design variables to be at the design variable bounds. This is a concern and should be analyzed.

p. 7 - concerning: Optimization visualization and evaluation

Additional information of the optimization is desired. Q1: How well is the optimization converged? Q2: How many design cycles / optimization steps have been taken. It is *very* common to visualize an optimization history by plotting the objective value as a function of the design cycles / optimization steps. The desire for additional information also includes e.g. how well is the flow problem converged? and, what are the incurred computational costs (i.e. computation time)?

p. 10 Why is it the Opt3, and not any of the other two, which is chosen as starting point for the ensuing thickening of the TE?

[Technical corrections]

p. 2: 'global' search optimization method. Explain intended meaning of 'global'. An opposite of 'local' (gradient-based) methods or?

p. 2: I would recommend always citing third-party software such as ICEM and FLUENT.

p. 3: In Sec. 2, we hear of the first, second, and third step in Fig. 1. Therefore, the steps should be clearly shown/marked in said figure.

p. 3, l. 4: the 'Pareto' term is mentioned throughout the paper. A visualization of the Pareto front would be beneficial.

p. 3, l. 10: The sentence starting with "The two-dimensional geometry ..." is incomplete. Please rephrase.

p. 3, eq. 1: Should probably be a full stop, if "The class ..." is capitalized.

p. 3, l. 16: insert 'and': "... range from 0 to 1" *and* "define the type of ..."

p. 3, l. 17: Erase separately. Use 'respectively'.

p. 4, eq. 5: the "i=0,1..." seems to miss a symbol at the end to conclude the sequence.

p. 4, Fig. 2: BPO10 is hard to see. Consider alternative marker/line

p. 5, l. 9-11: The ', m' seen multiple places seems superfluous.

p. 6, l. 3: The sentence starting with "In this paper, using..." should be rephrased altogether. Please spell out 'S-A' (and cite).

p. 6, l. 3-4: The terms (diffusion or convection) should refer to some equation.

p. 6, l. 5: I would cite the SIMPLE algorithm when introduced. (as well as spell it out)

p. 6, Fig. 4: consider showing the inlet and outlet zones in the figure.

p. 6, l. 13: Please describe the genetic algorithm. They come in many variants.

p. 6, l. 13-15: Please explain why/how these exact settings and AoAs are chosen.

p. 7, l. 3: What is meant with "main" parameters? The final design variables?

p. 10, l. 15-17: Very tough to verify on figure. Please improve Fig. 10.

p. 14, l. 1: Now that you mention the design time, then please report it.

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