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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Ground-generation airborne wind energy design space exploration" *by* Markus Sommerfeld et al.

Anonymous Referee #1

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GENERAL COMMENTS

Overall it is a good work. I appreciated reading the paper and I found interesting the results. I believe it needs some more physical explanations and interpretations to be a really high quality work. Here are my comments.

SPECIFIC COMMENTS

———- - Table 1

It seems that all your results above rated power are directly influenced by the tether values because the power is the product of F_{tether}^{max} and $\dot{l}_{tether}$. This should be clearly stated in the text and in the conclusions. A design space exploration would investigate the effect of changing these constraints on the power output. Maybe, consider

changing the title (I agree with the other Comment)

———- - Line 182

Have you tried to start from different initial conditions (i.e. different circular loops) to find the global optimum and avoid local optima?

———- - Line 278

It is not clear to me why higher lift coefficient results in higher rated power when the rated power is just the product between reel-out velocity and tether force, which are constrained. Please clarify it.

———- - Line 301

Does the path length include the reel-in part? Please specify it. Is there any physical reason why the flight path remains constant with wind speed? Is this true also after rated?

———- - Line 304

You mention the minimal turning radius without introducing it. Please do that. The minimal turning radius is quite important. Have you a constraint on this? Can you show/ comment how large is the turning radius compared with the wing span? A too small turning radius divided by wing span results in a big difference is tangential velocity between inner and outer part of the wing.

———- - Line 305

For conventional WTs, the evaluation of Cp always requires the evaluation of the axial induction at the wind turbine. In this work, I suppose, the induction is neglected. Please state it here.

Since for AWESs the induction is typically neglected, the concept of swept area loses its typical meaning. Indeed, the reference area is the kite wing area in Loyd equation.

This is why in AWE, the Power harvesting factor (see "Airborne Wind Energy: Basic Concepts and Physical Foundations",Moritz Diehl in "Airborne Wind Energy", Ahrens, Diehl, Schmehl (2013) - pag 18) is defined and not the Cp you define in this paragraph. I believe that introducing this factor in your considerations and plots would make your conclusions more understandable.

Moreover, the power losses associated to the path are typically associated to the cosine of the opening angle (angle defined by the tether length and the turning radius) powered by 3 (see section 4 of "The Influence of Tether Sag on Airborne Wind Energy Generation", Trevisi et al, (2020) for more details). It could be interesting to include this term in your considerations.

———- - Line 390

Why half of the tether drag and the intere tether mass? I do not see the physical reason. Can you elaborate?

———- - Line 405

Did you use include the tether drag in consistent way with literature for the evaluation of the system glide ratio ($\frac{L_{wing}}{D_{total}}$)? For instance see equation 4.8 in "Efficiency of Traction Power Conversion Based on Crosswind Motion",Ivan Argatov and Risto Silvennoinen in "Airborne Wind Energy", Ahrens, Diehl, Schmehl (2013). Using the mentioned equation can be a simple check for your results.

———- - Line 424

Can you explain how you computed the tether drag power loss?

TYPING ERRORS

———- - Line 427

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