

Comment on wes-2021-155

Anonymous Referee #1

Referee comment on "Parameter analysis of a multi-element airfoil for application to airborne wind energy" by Gianluca De Fezza and Sarah Barber, Wind Energ. Sci. Discuss., <https://doi.org/10.5194/wes-2021-155-RC1>, 2022

General comments

- Interesting work on using multi-element airfoils for Airborne Wind Energy. While I believe multi-element airfoils can be beneficial for AWE purposes, not much research has been conducted so far in this area. I'm also interested in future work considering optimisation algorithms, including tether drag and 3D effects.
- The figures presented in the paper are clear and add to the understanding of the paper.
- Be a bit more critical of your results and the use of multi-element airfoils in general. Also, discuss possible disadvantages of using multi-element airfoils as well as possible limitations of the models you used. (See specific comments.)

Specific comments

- 1 .Introduction
 - 49: Explain why multi-element airfoils stall at higher angles of attack. How is the flow affected using multi-element airfoils?
 - 56: It is stated that a multi-element airfoil has a higher aerodynamic efficiency. This cannot be stated in general as this is highly dependent on the metric you are using to assess the efficiency and the specific conditions. Nuance under which conditions and which metric multi-element airfoil can be advantageous.
 - 76: Stress out more why exactly multi-element airfoils are beneficial and how they are beneficial for AWE. Multi-element airfoils can reach much higher C_L than single element airfoils, but this comes at a cost of higher C_D . To my knowledge, multi-element airfoils do reach higher C_L/C_D than single element airfoils. However, for AWE, power scales with $E^2 C_L$ (Loyd formula), using this metric, C_L is more important, and multi-element airfoils can be beneficial. Moreover, the drag of the tether also adds to the total drag, therefore the drag of the aircraft becomes relatively less important, another argument in favor of multi-element airfoil. I think

your research should contribute to validating the above statements.

- Baseline Simulations
 - 94: At first sight, the presented geometry doesn't look like the DU 00-W-401 airfoil. I had to look up the paper of Ragheb and Selig to understand where the MFFS-018 multi-element airfoil comes from. This is not a very typical multi-element airfoil configuration because of the extra Strut, so I would explain a bit more in detail the choice for this geometry.
 - 97: transonic Mach numbers are not relevant to your problem.
 - 107: Explain how 3D effects could influence your results.
 - 134: I would say that MSES under-predicts the drag and that OpenFOAM is closer to reality as it is a higher fidelity model.
 - 145: Comment on how it would influence your results if the drag of the tether is taken into account. Personally, I think it would be very interesting to include this term as it is very relevant for the AWE community to understand how the tether influences the design of an AWE aircraft. Furthermore, it could be relatively easily implemented by assuming a certain drag coefficient, length and diameter of the tether.
 - 165: I would not consider a change of 6 degrees in AoA small ...
- Airfoil optimisation
 - 271: "multi-element airfoils have a high potential for application to AWE systems." Be specific. On what result is this conclusion based? You did not compare with single element airfoils in your study.
- Conclusion
 - I would not call this a conventional wind turbine airfoil, the airfoil is far from conventional.

Technical corrections

- 74: For these studies. the optimization criteria ... à remove ". "
- 128: I find "feasibility" a confusing term here, consider using "verification"
- 145: Consider rephrasing "on request of the designer", and explain in more scientific terms why the drag of the tether is not included.
- 156: Main leading edge
- 239: "rounder and beneficial aerodynamic shape" Vague description, be more precise in explaining results.
- 302: Consider: This study has shown that significant improvements up to 46.6% in E2CL are possible.