Rebuttal of: “Computational aerodynamics for leading-edge inflatable kite design”

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1 General comments (RC2)

1.1 Specific comments (RC2)

> **320: Are there any physical considerations for the seam angle and the dynamic search? Any physical insights on the effects of the curvature distribution on the flow field?**

Yes, both aspects have a physical basis, which we now state explicitly in the revised manuscript (Sect. 3.1). The seam is the stitched junction between the canopy and the LE tube; since a tensioned membrane cannot sustain a bending moment, the canopy must depart the tube surface tangentially, which motivates the enforced tangency condition. The dynamic search selects the smallest seam angle for which such a tangent departure is compatible with the prescribed maximum camber, generalising earlier fixed seam-angle definitions that can produce invalid geometries for weakly cambered profiles.

In addition, on the physical kite, the seam acts as the roughness element that trips the boundary layer, linking the seam location to the fully turbulent modelling assumption (App. C). Regarding the curvature distribution: since surface curvature sets the local pressure gradient, ϕ redistributes the suction along the front spline. Within the physically consistent range, however, this redistribution only slightly alters the pressure distribution and has a negligible effect on the integral coefficients (Masure, 2025), as the dominant flow features of LEI airfoils (the tube suction peak and the pressure-side recirculation) are governed primarily by t, κ, and η. This is why ϕ was held fixed during dataset generation.

> **335: I would replace “computational cost” with something like “the effort required for case set-up” as computational cost generally directly refers to the solution cost.**

The wording has been changed to refer to the effort required for case set-up, reserving “computational cost” for the solution cost.

> **335: I would also refer to the number of elements in the mesh.**

A reference to the number of elements in the mesh has been added at this point.

> **340: Shouldn’t the number “eight” be written as 8 since it is a parameter? Same with “five”.**

The numbers are now written as numerals (8 and 5), since they refer to parameters.

> **360: I would reword “vector inlet velocity” as “inlet velocity vector”.**

The phrase has been reworded to “inlet velocity vector”.

> **375: “converge to 1e-4” would suffice without saying “within”.**

The word “within” has been removed, so the sentence now reads “converge to 10^{-4}”.

> **380: What does “initial convergence” vs. “final value” mean here? The point about rapid convergence is not clear.**

In OPENFOAM, each outer SIMPLE iteration reports two residuals per variable: the initial residual, evaluated on the newly assembled linearised equation before the inner linear solver acts, and the final residual, obtained after the inner linear solve. The initial residual measures how far the field from the previous outer iteration is from satisfying the current equation, and therefore tends to zero as the nonlinear problem converges; the final residual merely reflects the inner linear-solver stopping settings. For this reason, the built-in RESIDUALCONTROL stopping criterion acts on the initial residual, and this is the quantity we monitor. The point about “rapid convergence” was indeed unclear, and we have rephrased it: the automatic stop acts on residuals only, so a case whose residuals drop quickly could terminate before the force coefficients have settled to the 10^{-4} level. To prevent such early termination, the stopping threshold was set slightly below the nominal residual criterion, at 8×10^{-7} for all flow variables, giving the force coefficients additional iterations to converge under one uniform stopping rule. The corresponding paragraph in Sect. 3.4 has been rewritten accordingly.

> **405: Are these cases generated automatically within the design space? What is the computational resource requirement for each case based on the grid size?**

Yes, all cases were generated automatically: the parameter combinations span the full Cartesian product of the design-space ranges (Table 2), and for each combination the geometry construction, meshing, and case setup are scripted end-to-end. Every simulation used the same structured mesh of approximately 1.1×10^5 cells (575×201), decomposed over 4 cores, and was limited to 5,000 SIMPLE iterations. With 1.4×10^5 core hours for approximately 1.4×10^5 simulations (training and test sets across the three Reynolds numbers), the average cost is approximately one core hour per case, i.e. roughly 15 minutes of wall-clock time on 4 cores. We have added the automation statement and the per-case cost to Sect. 4.2.

> **415: “..smaller than the tube radius”**

The phrasing has been corrected to “smaller than the tube radius”.

> **480: “A corner eddy closer to the..”. I would reorganize this sentence.**

The sentence has been reorganised as suggested to improve readability.

> **485: “Increasing alpha from 2 to 8 leads to a more concentrated and...”**

The sentence has been rephrased following the suggestion.

485: “One encounters three pressure side surfaces”. You do not need to say “both” here.

The word “both” has been removed.

585: Are the results sensitive to the perturbation step size?

We verified that the reported derivatives are insensitive to the finite-difference perturbation step. Using central differences, we swept the angular step over $0.03°–1.1°$ and the rate step over $0.005–0.1$ rad/s about the trim state; every reported derivative varied by less than $0.3\,\%$ and $1\,\%$, respectively, confirming that the chosen steps lie on the finite-difference plateau. Sensitivity emerges only for unphysically large steps: angular steps beyond $\approx 3°$, which perturb the section into the nonlinear/stall regime, or rate steps beyond ≈ 0.2 rad/s, beyond which the quasi-steady solver ceases to converge. A sentence noting this has been added to Sect. 5.5.

Overall, there are some sentences that I would rephrase for better grammar and better conveyance of the ideas in the manuscript. Also, I see way too many commas, not all of which are necessary. Cleaning up the writing should improve the quality of the manuscript.

We have removed unnecessary commas and rephrased several sentences throughout the manuscript to improve grammar and readability. An overview of all changes is provided in the tracked-changes file.