Review_1

This paper presents the implementation of a cascaded controller to facilitate the launch and landing manoeuvres of a tail-sitting flying-wing airborne wind energy system. The study considers a 6 DoF model in tethered flight.

Major comments

1. In general, it is difficult to identify the paper's contribution, at least in its current form. For example, the first half of the abstract (up to 'at varying wind speeds and the limitations imposed by the tether') is just a general introduction to airborne wind. The second half contains somewhat generic statements about the controller and the analyses ('concept is subjected to analysis taken into account specific system parameters', 'a flight regime can be identified. This is considered in the design of a guidance controller, which represents the top level of a cascaded flight controller'). As it is now, the paper reads like a technical report that implements existing technologies on an airborne wind system. The authors should consider highlighting the novelty aspects of the work: is it in the roll-yaw manoeuvre or something else that differentiates or improves upon the existing solutions?

> The revised version specifies the novelty of this work in the abstract in a more precise way

2. Section 2, where the flight manoeuvre is described, is hard to follow. This is partly because the authors combine discussing the literature with pure technical discussions of the manoeuvre (for example, between lines 135 and 171, all of which are grouped into a single paragraph). As a suggestion, this section could be split into multiple paragraphs, first describing the existing solution (pitch transition), followed by one on the yaw-roll transition, with separate figures. Please feel free to adopt a different approach if the authors think it would improve readability.

>I reformulated many parts of this section and included more line breaks to enhance its readability. I also modified the figure illustrating the pitch versus curved yaw-roll transition.

3. The motivation of the trim study (section 3.3) needs to be clarified. Is it to determine the controllability of the system during a maneuver? If so, how does the existence of a trim state relate to controllability? A trimmed system can still be uncontrollable.

> I added a clear motivation for the trim analysis. I agree that a trim state can still be uncontrollable- But in fundamental static analysis, trim states with **controls acting within their operational limits** can be considered controllable.

4. Also on the trim study, my understanding of the term 'trim' is that the system is in equilibrium. However, the authors state on lines 242-243 that 'A trimmed state is given when the equations of motion (Eq. (1) and Eq. (2)) are satisfied'. Satisfying eqs. 1 and 2 only means that numerical time-integration can be performed to generate a time history like in figures 13-15. I do not understand how this relates to a trim condition.

> I clarified this- in 256-257 specify my definition of trim state and controllable state.

Minor comments

5. In section 5, it would be useful to show the control effector movements in the time histories (elevons and throttle levels), along with some discussions on whether the movement commanded by the controller is realistic.

→I considered this, but then my plot became extremely large, and I wanted to focus on the guidance parameters. During the simulated flight, the elevon deflection is below 10°, and the mean throttle lever is at about 0.6 in the hover flight phase, which goes to 0.4 in wing-borne flight. We published more on the elevon deflection specifically during the pure yaw roll transition in:

Fuest, H., Duda, D. F., Islam, T., & Moormann, D. (2023). Flight path and flight dynamic analysis of the starting procedure of a flying wing as airborne wind energy system. *Deutscher Luft- Und Raumfahrtkongress, Braunschweig Germany 2023*. https://doi.org/10.21203/rs.3.rs-3847829/v1

6. Not much is said about the tether model. Can the authors give a few basic descriptions, such as whether the tethers are split into multiple sections, and provide some indications on the stiffness, damping, and aerodynamic loads on the tether?

> I added more details

The authors are invited to consider these comments before submitting a revised manuscript.

Review_2

General comments:

This work presents a guidance concept for a flying wing tailsitter AWES applied to the takeoff and landing maneuvers. A controller architecture is described, and the results of a trim analysis and a dynamic simulation are presented. The work presents a valuable study and solution to its topic, but lacks clarity and has inconsistencies which must be addressed.

Specific comments (major):

- The introduction reads as a rather extensive review of the different solutions developed by AWE companies and their way of operation. After reading both the abstract and the introduction, it isn't clear what is the gap in the state-of-the-art tackled by this work, neither its contribution nor its novelty. Reading further, this seems to be more properly addressed by the second half of section 2. The authors should consider restructuring these sections to make this information clearer to the reader earlier in the paper.

  > The revised version specifies the novelty of this work in the abstract.

- It is unclear whether the tether length ratio k >= 1.05 is chosen arbitrarily or as a conclusion of some previously cited work (line 129). Would the results change significantly if this parameter was to be altered? How do the deviations in height and radius reported in Section 5 relate to this assumption?

  >The revised version is more general in this part- a specific k is considered in the actual implementation and not the concept.

- The definition of trim state in line 224 seems to contradict the one given later in 243. Satisfying Eq. 1 and 2 does not imply that all forces and moments are balanced as previously stated.

  > I clarified this- in 256-257 specify my definition of trim state and controllable state.

- The transition ratio is presented as "the ratio of the aerodynamic force to the gravitational and tether force" on line 264. Then Fig. 8b refers to it as Fa/Fres, being Fres never named in the text. Moreover, in line 418 and Figures 14, 15 and 16 is redefined as Fa,zb/G, which seems to imply that the tether forces are actually not being considered.

> I clarified this- tether force is not considered to distinguish between wing- and prop-borne

Specific comments (minor):

- Line 58: "*Conversely, the objective is to design a fixed-wing AWES but eliminate a rotating launch catapult mechanism and enable the airborne system to operate more independently*." It is confusing whether this is stated as an objective of the authors' line of work, or as being an goal of the company mentioned right before or the field in general.

  >Reformulated this entire part

- References Fuest et al. (2021a) and (2021b) share the same DOI, journal, etc. I haven't been able to find a paper with the title described in 2021a.

  >Checked and corrected

- The authors present 4 coordinate systems (cylindrical, geodetic, body-fixed and wind) in Section 2 between lines 160 and 163, then an additional fifth (aerodynamic) and sixth (tether) on Section 3.2. Some of them are not completely defined in the text and must be interpreted using Fig. 4. I would suggest to the authors providing more precise definitions of each coordinate system as well as considering restructuring the information to enhance readability.

  > I tried to present the coordinate system in a better way- However, I also refer to others.

- If feasible, the clarity of description of the Guidance Controller would improve if the intermediate signals in Fig. 12 were named, just like in Fig. 11, and the input/feedback signals were included on both Figures. The authors should also consider providing a block diagram detailing the architecture of the inner controllers.

  >I named the signals and I give further details on other papers that consider the different sub-controllers, as I don't want to focus on these in this work.

Technical corrections

- Line 182: "*As shown in Fig. 1, winglets are attached […]*" Probably should be referring to Fig. 5b. >is done
- Line 294: phase(iv) → phase (iv) >is done

Review_3

General comments

This paper presents a guidance approach for launching and landing phases of a flying wing airborne wind energy system (AWES) with vertical takeoff and landing (VTOL). Using a demonstrator model, a comprehensive trim analysis of launching and landing is performed to identify the flight regime. The control architecture consists of a proposed guidance controller, at the top level, and rotational and transnational controllers at the lower level. Simulation studies are conducted to test the control approach.

The paper includes solid work, but it's hard to follow the writing at some places.

Specific comments

- Highlight key (novel) contributions in the abstract (guidance concept, trim analysis, guidance controller design).

  > revised version specifies the novelity of this work in the abstract

- Explain the meaning of minimum phase characteristic. Why is this a challenge to control?

  > is explained in the revised version

- The trim analysis is comprehensive, but the writing needs to be elaborated, e.g., explain the meaning of trimmed/non-trimmed states, describe the steps of trim state computation. Why 16 path points are selected in the simulation? How was the transition ratio defined?

  > I added a clear motivation for the trim analysis, and why I selected 16 path points.

- In Line 282-28, how to see that the results satisfy the general trim condition(s) but not the extended trim conditions? It's also difficult (for the reviewer) to follow discussions based on the results in Fig. 10.

  > I enhanced this part and added more line breaks for better readability.

- The guidance controller development is a novel contribution, isn't it? Explain why/how the architecture in Fig. 12 was proposed.

  >I enhanced this part- hopefully, it is better to understand my structure.

- Is the model including Equations (1) and (2) nonlinear? What was the model used in LQR design, Section 4?

> I wrote that the model used in the LQR-Design is a linearization of the translational controller.

- How was the decoupling obtained for the velocities and the positions, respectively?
  >I can formulate the transfer function of the commanded acceleration to the actual acceleration within the body frame and through the actuators of the translational INDI. As my translational controller has four controls, I must consider four actuator dynamics. Within my translational controller, I identify the fraction of effect each actuator has on the different coordinate axes, and I use these fractions to superposition the acceleration commands accordingly. I added screenshots from my Simulink implementation that may help you understand this if you are interested. In this paper, I did not want to go too deep into this design aspect since I think it would distract the reader and loosen the focus on the guidance concept.

Minor comments on writing

- Reduce general descriptions on AWE systems in the introduction. Go straight to the most relevant points on flying wing tailsitter AWES with VTOL.

  >I reduced this in parts and enhanced the structure

- A large part of Section 2 reads like review of existing development (up to '... in an AWE context,' line 148). Consider to move these writings to Introduction, that will give a stronger review with gaps and motivation/objectives naturally described.
  >I modified the part and tried to review less existing development. Still, I also see the need to refer to specific developments here and there when I discuss why I selected, e.g., the specific yaw transition and not the pitch transition...

- In Figure 4, when multiple coordinates are introduced, add arrows to each direction.

> arrows are added

- In Line 182, 'Fig.1' should be 'Fig.5.'

  >Is corrected

- In several sections, it might be helpful to put launching and landing in separate sub-headings or bullet points.

  >I did not specifically add sub-headings, but I structured the text with more line breaks and enhanced the formulations for better readability.

Review_4

The paper proposes a novel launching and recovery method for tail-sitter vertical take-off and landing (VTOL) Airborne Wind Energy Systems (AWES).

This suggested method is interesting as it investigates a new concept within the launching and recovery phase of AWES, an area that necessitates further research.

The authors adopt a systematic and relevant approach to analyze and evaluate this new technique.

I have minor comments on the manuscript as follow:

1- In page 1, line 24: *"it exits the generation phase and enters the recovery phase"*:

Recovery usually used for terminating flight operation (e.g. landing), I suggest to use retraction phase instead, its most common used for pumping cycle in the literature.

>I Agree- it is corrected.

2- In page2, line 30: *"However, most emphasize the energy-harvesting flight, not the launching or landing"*:

I don't agree with this, there are papers in the literature discussing the take-off and landing for AWES, the authors need to mention them and state the difference in his research.

>I removed this part

3- In page 2, line 41: *"As soft-wing kites are prone to exhibiting markedly inferior aerodynamic performance in comparison to fixed-wing airborne systems":*

Why? the author should provide reasoning to this.

>I specified this part and corrected my statement. I only say:
Rigid wings are durable and can achieve higher aerodynamic lift to drag ratios than soft-wing kites due to high aspect ratio wings. In addition, they can be designed with efficient aerodynamic profiles that do not deform in flight.

4- In page 5, line 113: *"the direct force control from the airborne system during vertical flight is accompanied by a pronounced minimum-phase characteristic"*:

More description for this is need (explain). > The revised version describes this in detail

5- In page 5, line 116: *"Makanis M600"*:

apostrophe is missing.
>is corrected