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Atmospheric Measurement Techniques
Discussions

Interactive comment on "Real-Time Estimation of Airflow Vector based on Lidar Observations for Preview Control" *by* Ryota Kikuchi et al.

Anonymous Referee #2

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Within this manuscript, the authors present a novel technique for measuring the headwind/tailwind and vertical velocity ahead of an aircraft for preview control using Doppler wind lidar. The authors present the method and use simulated observations to assess the accuracy of the method, with respect to traditional approaches. The authors demonstrate using these simulations that the proposed technique is more accurate and will meet requirements for preview control. However, the authors do discuss in the conclusions some limitations in detecting small-scale turbulence (i.e., wakes from other aircraft likely cannot be properly detected).

This paper fits well into AMT's scope and will be of interest to its readers, particularly those in the aviation applications community. As such, I suggest that this manuscript be accepted contingent on the following comments are sufficiently addressed to clarify

several aspects of the paper and methodology to readers.

Specific Comments

a) Line 27: Add a reference to this 2014 FAA study or report.

b) Line 28: How many fatal accidents were observed in this time frame?

c) Line 34: Are these turbulence-related accidents results in LOC-I? I don't exactly follow the logic presented here, and if LOC-I accidents are related to CAT (which is the main topic of the paper). Please clarify how statistics in this whole paragraph are related to each other and relevant.

d) Line 38: There are numerical predictions of CAT. Please add a statement and provide any supporting references for if/why these are insufficient for avoiding CAT.

e) Line 42: Rephrase the sentence 'Aerosol particles are received instead of laser beams due to a scattering light effect caused by the rain particles', as it is unclear. Does this mean that the dominant signal comes from raindrops, which are not passive tracers of air motion (whereas aerosols can be safely assumed to be passive tracers due to their small size).

f) Line 48: How far in front of an aircraft can CAT be detected?

g) Line 75: This is not true. A single lidar can measure the vertical velocity if the beam is scanned at different angles (e.g., upwards and downwards using a prism). It is only not possible when the beam is fixed.

h) Line 92: Clarify there and throughout that the horizontal wind (u and v) is not measured, rather only the component that is parallel to the look-direction (i.e., headwind/tailwind component, not crosswind).

i) Sect. 2.1: Please provide more details on the Doppler lidar itself. Does it use heterodyne- or direct-detection? What is its wavelength, PRF, pulse energy, bandwidth, aperture diameter, etc? How many pulses are averaged? What is the data rate?

Also list any other relevant details and provide a written description of the system.

j) Line 120: Where do these requirements for the frequency/accuracy come from?

k) Line 131: Change 'areas' to 'distance', as area connotes a 2-D space. Also change the wording 'area' in Fig.2.

l) Figure 2: The circles in the figure make it seem like the lidars are sweeping out a scan circle (similar to a conical scan). This is not true, suggest removing the circles.

m) Line 156: Why was a first-degree polynomial used and not a higher-order polynomial?

n) Sect. 2.3: It would be helpful if a figure could be added showing one more multiple example spectra (preferably for both a valid and invalid measurement), also showing what these values (k_1st, k_2nd, k_ave) signify.

o) Lines 175-189: It would also be help to add a figure showing how exactly the LSM estimation is used to QC bad measurements. Once invalid measurements are removed following this LSM quality-control process, is the initial LSM fitting done again to obtain a better estimate of the wind? I would think this process could be repeated until there are no more poor LOS estimates going into the fitting.

p) Figure 5: It makes sense to show the vertical velocity with its sign, not just it's magnitude, in this plot, as the sign is expected to change around the vortex.

q) Figure 6: I don't really think this figure is valuable and it could be removed. The only information it contains that is not in the text is the dimensions of the model volume, which could be stated in the text instead.

r) Figure 7: I suggest using a divergent colorbar (i.e., a colorbar that is either white or grey for w=0), which is typically used for vertical velocity. It would be helpful to add the modeled flight path to this figure.

s) Lines: 271-275: These lines would be best in the caption for Figs. 9 and 10, that way

the reader doesn't need to refer back (several pages in the text) to understand what is in Fig. 9 and 10 when examining those figures.

t) Line 275: Clarify what is meant exactly by 'after 10 s or 15 s'?

u) Line 301 and 331, 389: How are the pseudo-routes generated? Are they at random locations in the vortex, or staggered? Are there limits to the heights that they are limited to?

v) Lines 322-325: These lines also would be best in the caption for Figs. 11 and 12.

w) Fig. 12: The colorbar axis on the right plots is not correct. It shows vertical winds of 8 m/s, but the values shown for the NWP output (Fig. 7) did not exceed 2 m/s.

x) Lines 391-392: This text should be moved to the caption to describe what each panel indicates.

y) Line 425: One notable exception to this is wakes from other (larger) aircrafts. These localized but intense vortices pose a safety hazard. The authors should specifically state here that these hazards will not be detected with this technique.

Editorial Corrections

a) Line 87: Change 'smaller than that in the atmosphere' to 'smaller than at lower altitudes'.

b) Line 151: Remove one instance of the word 'method'.

c) Figure 3: The top-middle lidar beam should be labeled T-1, not T-2.

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