

Interactive comment on “Flywheel calibration of a continuous-wave coherent Doppler wind lidar” by Anders Tegtmeier Pedersen and Pedersen Courtney

Anonymous Referee #3

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General comments

The paper of Pedersen and Courtney is well structured and written. They are thorough in their way of deriving models, uncertainties and finally comparing it to measurements. Their approach to use a flywheel in combination with a Doppler wind lidar seems new and worth publishing (after minor revisions).

Specific comments

Concerning the estimate of θ_1 (P12L5-6 and P16L18-21). Did you also measure backscatter? Why not look at the plot of tilt vs backscatter? I suppose it should be increasing from θ_0 to θ_1 strongly and afterwards only slightly (if at all)? If it turns out

that the increase in backscatter shows no point of change around θ_1 , just make a different set up where you place something (with a sharp edge) on top of the (not turning) wheel and tilt and measure the backscatter as the beam hits the object first partially and then completely. Now the plot should just show an increase in backscatter from the angle where the beam touches the object partially to the angle where it hits it completely and after that stay constant? The difference could be an estimate for $\Delta\theta$? (To avoid backscatter from walls, use window or something that reflects at an angle as background?). If my thoughts on this are correct but a new setup/measurement is too time consuming please address/discuss this appropriately in the document.

In section 3.1 you describe your approach to rotate around the transceiver lens *for the model*. But I did not see you describing where the tilt-axis lies relative to the telescope *for your measurements*. If you raise/lower just the end so it rotates around its lens (As the caption of Fig.2 suggests), please include this information somewhere. If the tilt axis is not going through the lens please also address this (maybe add some text that makes clear that the changes/differences to L and y_r are negligible)

Although it is obvious that no wind speeds are measured because the title says "flywheel calibration" - It is after all a "Doppler wind lidar". As someone who uses a Doppler wind lidar to measure wind speeds it feels a bit weird to read the whole paper and end up just with a calibration "for rotating steel". I of course prefer a lidar that goes through such a quality check, but still... the journal is ATMOSPHERIC Measurement Techniques... Maybe you could add a paragraph about how and why this translates to wind measurements or state that this calibration is meant more as a necessity/possibility than as a sufficiency for Doppler wind lidars quality? (This may be a matter of taste... if you feel all is clear by using the word "calibration" that is also fine)

Technical corrections

Code and data availability: Pedersen, A. T.: Flywheel calibration of coherent Doppler wind lidar - data, <https://doi.org/10.11583/DTU.11991189>, 2020.

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<https://amt.copernicus.org/preprints/amt-2020-88/> says "Anders Tegtmeier Pedersen and Pedersen Courtney" and the paper itself says "Anders Tegtmeier Pedersen and Michael Courtney"

There are a bunch of "r"-index is missing: EQ9, P6L15-16, EQ10, P7L5/6/9/11

In the text and figures, you use different styles of the Greek phi (ϕ/φ). Please make this consistent.

You use "best" 5 times in the document. When you say "our best" I get it, but just "best" is a bit bold. Maybe rephrase some occurrences.

P2L19-20 The reference to Fig.1 makes it seem like we should be able to see the inclinometer on top of the telescope. I don't see it... maybe use labels / zoom in the Fig.1 or if it is an old picture without inclinometer move the Fig.1 reference to one sentence earlier?

P6L8 "this" is ambiguous. Maybe use "the right hand side divided by V_{wheel} "

EQ8 θ should not be there, right?

P6L15-16 not listed as equations

P8L15 should be $y_r - R \leq y \leq y_r + R$ or $-R \leq y - y_r \leq R$, right?

EQ17 ϕ is missing "r"-index

EQ17 I don't follow the last equal sign. Please explain, expand or correct.

P10L4 "as long the" -> "as long as the"

P11L14 "cause" -> "causes"

P12L10 "arise" -> "arises"

P13L8 "wee" -> "we"

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P14L5 "the are" -> "there are"

P14L19 "shown i the" -> "shown in the"

P14L18-20 Please check the sentence structure again. The last bit doesn't seem right. Maybe "way than" -> "way other than". Maybe even rephrase as "direct angle measurement" is ambiguous. Did you mean "direct angle measurement from inclinometer"?

P15L8 "assume" -> "assumed"

EQ38 index c_c should be b_c

EQ39 I don't follow this transformation. Did you swap "wheel" and "LOS"?

P17L3 "0.14m" -> "0.14 mm"

P17L7 "Table2" -> "Table 2"

P17L15-17 Sentence looks wrong. Maybe "measurement widening" -> "measurement is widening"?

P19L4 "shape curve" -> "shape the curve"

Cosmetic suggestions

(These need not be address)

P5L4 "rearranging and inserting into Eq. (1)" with the page break - I found it hard to follow (first time reading), that you also use eq.3 in this step.

Fig.6 An arrow for $wR_e \cos(\phi_{i_r})$ could be nice, but I guess it overlaps with the red line? (Maybe dashed or dotted arrow?)

P13L1 double usage of "end" is hard to read

P15L22-26 I would rephrase it... explain/motivate u_{θ_w} differently.

P17L6 "relative uncertainty of" -> "relative uncertainty u_{θ_w} of"

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P17L7 "absolute uncertainties can" -> "absolute uncertainties $u_{\Delta\theta}$ can"

Fig.9/10 different colour for residuals lines?

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