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Atmospheric Measurement Techniques Discussions

Interactive comment on "Solar tracker with optical feedback and continuous rotation" *by* John Robinson et al.

Anonymous Referee #1

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The manuscript under consideration presents a carefully designed and tested solar tracker for stationary ground-based direct sunlight observations. Such solar trackers are essential for greenhouse gas observing networks like the Total Carbon Column Observing Network (TCCON). The pointing accuracy of solar tracker must be better than 0.05° to reach the measurement precision such networks strive for. To fulfill this obligation, the authors developed a solar tracker with an optical feedback loop based on solar image edge detection, achieving a pointing accuracy of 0.02°. Furthermore, their design is mechanically robust and and designed for long-time use, avoiding failure due to mechanical fatigue of moving wires by replacing them with a coaxial power transformer. This solution also enables the continuous rotation around the azimuth axis, which is especially useful in polar regions. Alongside the carefully chosen hard-

ware which is very likely to be supplied in the future, these developments provide an excellent solution of a durable, reliable, and precise solar tracker.

The topic addressed in this manuscript match well with the scope of AMT. The text sometimes becomes hard to follow, mostly because a lack of clear structure. I recommend ordering the information more hierarchically to avoid raising questions to the reader which only get answered much later in the text, especially in section 3 (Optical feedback). Also, many adjectives used either need to be more precise or put in context, otherwise they provide no distinct information (e.g. good, large, small).

General comments

Line 115 ff: Re-structure paragraph. First, give the numerical value of the error when declaring it as significant, then describe how you arrived at this value and present your solution strategy last.
Line 130 ff: Please describe your alignment process in more detail. What would be specialist tools, or is it the level laser you've used? Why is the movement of 2 mm of a 5 mm diameter spot difficult to resolve?
Line 157 ff: The following chapters 3.1, 3.2, and 3.3 are hard to comprehend since the information are badly structured. I'd very much appreciate an explaining sentence on how your feedback system works in the first paragraph. If I've understood it correctly, you are not actively tracking the Sun solely by the optical feedback system but are primarily relying on astronomical calculus. The optical feedback than adjusts the error offset vector in a manner that the astronomical calculations provide a sufficiently precise pointing, which is the state you call "locked". Please introduce your concept in the beginning before going into details.
Line 177: How do you approach this trade-off in image size and intensity?
Line 183: The partly illumination of the photodiodes is important to get the basic idea of the feedback loop, mention it earlier.
Line 190 ff: Algorithm description hard to comprehend. Please introduce in a clear way

- what's the threshold and hysteresis parameter?
- how does the algorithm steer the motors and what happens if parameter bounds are crossed?

Line 218: Name the parameters you use for the feedback correction and explain why they are sufficient.
Line 230: Again, you use "the parameters" without naming or explaining them. This would help a lot following your characterization approach.
Line 318 ff: Give manufacturer and description to each compartment, e.g. Bluetooth module
Line 393: On which stations are these Trackers?
Line 404: Description of parameters must be given in algorithm chapter.
Figure 13: How long are the averaging periods?

Specific comments

Line 12/13: Use of "simple" and "just" unnecessary.
Line 48: Can you provide the reflectivity range of the mirrors?
Line 59: Chapter 2 only covers mispointing of passive solar trackers, please add this.
Line 67: Define "vital" role, sth. like "Our trackers enable direct sun observations at sites XY..."
Line 76: Define "small changes"
Line 78: Add "passive" to the chapter title
Line 97: "required" instead of "needs used"
Line 139/40: remove "simple" and replace "good" with something more descriptive
Line 158: Either remove "large" or put it into context
Line 169: Remove "very"
Line 173: "[...] adjustments performed by another mirror." The figure caption calls this the alignment mirror, since it, as explained later, is used to adjust the optical axis onto

the feedback plane. Be consistent with naming and explain parts at first occurrence in the text.
Line 186: What's an adequate diode size relative to image?
Line 213: Sentence structure is weird, either introduce both approaches using colons or neither one, I'd go with the latter.
Line 231 ff: Mention that you move the image on the feedback plane. Also, describe in further detail how you determine the angular offset.
Line 239: "consecutive" implies successive days, but 6 month lay in between, I'd recommend another adjective.
Line 259: Can you give a notion how reliable the software has proven to be, e.g. a number of failures during the 11 year period?
Line 261: Maybe give examples, see e.g. Heinle and Chen (2018) (doi: 10.5194/amt-11-2173-2018)
Line 277: remove "simple"
Line 284: make clear what you're comparing to with "greater".
Line 327: Define why the modules are "Good"
Line 390: remove "very"
Line 444: Your title poses a question, give a decisive answer in the following paragraph.
Line 467: "works very well" → e.g. "surpasses precision requirements"
Line 469: replace "good"

Technical corrections

Line 55/56: space between numbers and units "2 mm", please add the space everywhere in the text.
Line 128: horizon*t*al
Line 287: so *IT* is ready
Line 291: present tense "use"
Line 326: "of" should be an "a"
Line 330: "[...] inside *OF* the [...]"

Line 333: space after "Fig."
Line 372: space after "Fig."
Line 575/576: DOIs in references missing
Line 580: "&ndash" in reference

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