EGUsphere, referee comment RC2
https://doi.org/10.5194/egusphere-2022-726-RC2, 2022

Comment on egusphere-2022-726

Anonymous Referee #2

Referee comment on "A new accurate low-cost instrument for fast synchronized spatial measurements of light spectra" by Bert G. Heusinkveld et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-726-RC2, 2022

The manuscript describes the design and performance for a new solar radiation sensor ("FROST") with spectral and broadband/hemispheric sensitivity. While there are limitations to the sensor, it is very low-cost and also provides some technical advantages in response time that the design team exploits. I agree with the design team that FROST could be of wide interest for several applications. The manuscript is suitable for publication in AMT but requires revision largely to increase clarity and provide missing information. The text is straight-forward, but could use improvements in organization. As I read the manuscript, I made many comments and notes only to find the answer appear much later. For example, there are two separate sections describing the cosine response. Consolidation of like sections and discussion would help. Additionally, I would like to see more of the analysis defended with quantitative data: For example, what were the results of the cosine tests in Section 2.4? My specific comments are as follows:

The manuscript requires copy editing: There numerous grammatical errors, unnecessary words, errant spaces, spurious pluralization, awkward wording, etc.

L59: I don't understand what you mean by "their vision".

L73: I know it's defined in the abstract, but you should also define GHI here.

L93-100: Doesn't this paragraph belong in Section 2?

Section 2: In Section 2 there are a lot of unanswered questions. For example, What serial protocol(s) the system uses for external communication? How data is archived; format,

volume etc. What are the temperature limits on components/power? What is the transmittance of the diffuser? How long does the battery last? Many of these questions are answered later in Section 3. Either general reorganization to Sections 2 & 3 or some additional text in Section 2 describing where more details will be found later is needed.

Section 2: Check the numbering of your subsections.

L179-186: What were the results of LED test? Can you provide a figure and analysis?

Lines201-210: The commercial grade SDcard seems like a significant and critical vulnerability given these fast read/writes. Have you considered more robust (and more expensive) aMLC/SLC industrial versions that might be more reliable?

L214: This DOI is password-protected. I can't get the Restricted Access for Review link to work. It's unclear to me if this information is to be open access or not.

L235: The BSRN reference is Driemel et al.:
https://essd.copernicus.org/articles/10/1491/2018/

L242-243: Are these filters the ones that were first discussed at L169-177? I think a little more clarity is needed here.

L250-254: Can we see these results in a figure?

Figure 5. What are the units? This is a fraction? Can you be explicit in the caption? Maybe this is defined later at L295 and that definition could be moved up to Figure 5? That said, I don't understand the definition. Further, because the radiance at the observed and interfering bands are different, I'm unclear how the fraction translates to a radiance bias.

L273: Wouldn't cloudy conditions actually increase crosstalk because the incident IR increases at all wavelengths?

Figure 6. For clarity, please label the green, blue, red sensors on the figure since this is how you refer to them in the text

Figure 8. I would like to know the performance cost incurred for including the KG filters. Two comments. First, please show the results for the KG1/red. This is particularly important because of the substantial transmission losses in the red band. Second, I'm also concerned that the results as depicted are deceptive. The responsivity is shown in normalized rather than in absolute units. Therefore, with the filter applied and the crosstalk removed, the in-band responsivities appear to increase, but they should decrease and I would like to know by how much.

L318-319: Why does the diffuser add crosstalk? Is it because the more light is collected at large zenith angles where the infrared signal is larger? Is it then primarily a clear-sky problem?

L325: Since you are comparing three versions, I feel like there should be three sets of symbols in Figure 10 comparing to the field spec, but I only see 2 (circles and pluses corresponding to versions 1 and 3).

L327: I'm confused about the world "calculated". Figure 10 are all measurements, yes?

Figure 13, 14, 15: Can you be more explicit in the legend about which sensor is which?

Sections 4 & 5: I think these can be just one section.

Section 3. The stated purpose of the diffuser is to increase the sensitivity of the sensor from the nominal 41 deg FOV to the hemisphere but it seems it should also provide the advantage of collapsing the cosine response function to a constant, specifically its value at 45 deg, the effective diffuse angle (Vignola et al. p.158). Notably, this effective angle is still outside the FOV and the consequences of that are not obvious to me. Can you comment on this?

Vignola, Frank, Joseph Michalsky, and Thomas Stoffel. *Solar and infrared radiation measurements*. CRC press, 2019