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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Experiments on magnetic interference for a portable airborne magnetometry system using a hybrid unmanned aerial vehicle (UAV)" *by* Jirigalatu Jirigalatu et al.

Anonymous Referee #1

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Overview: The manuscript details the installation of 2 QTFM magnetometers on a VTOL airframe and demonstrates the interference with flight data. This addresses relevant scientific questions within the scope of GI with multiple novel aspects; (1) the presentation of aeromagnetic data collected using a QTFM sensor, (2) the magnetic characterization of interference and data collection of a VTOL UAV.

Are substantial conclusions reached? -Yes. Are the scientific methods and assumptions valid and clearly outlined? -The authors are well read on the methods that exist. Assumptions are not clearly outlined. Are the results sufficient to support the interpretations and conclusions? -I am fairly certain yes. Unfortunately, due to the lack

of clarity I cannot say for certain. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? -No. See comments below. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? -Yes. Does the title clearly reflect the contents of the paper? -Yes Does the abstract provide a concise and complete summary? -It could be more concise. See comment below. Is the overall presentation well structured and clear? -It is well structured. It is not clear. See comment below. Is the language fluent and precise? -No. See comment below. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? -Yes. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? -The paper requires significant clarification. I believe the technical requirements can be met, but the English requires clarification in many instances. Are the number and quality of references appropriate? -This is fine. Is the amount and quality of supplementary material appropriate? -N/A

General comments: 1. I would recommend shortening the abstract. About 60% of it is introductory information and could be reduced to a couple of sentences. The abstract should be a "brief introduction of the topic". Also the abstract should include some specific results and should "mentions possible directions for prospective research." 2. My largest issue is the paper needs to thorough rewrite; not for technical reasons as much as the English is poor. This gets increasingly apparent after the introduction. It is filled with colloquial language, "we" and "us", and an excessive amount of connective words like "Besides", "Nevertheless", "furthermore", "consequently", "in principle", "however", "hence", "again and again", "on the other hand". On many occasions I had to guess the interpretation of a sentence and it is difficult to follow the idea being developed in many paragraphs. 3. The conclusion were adequate but I would request further information in a couple of areas that would help the reader accept these conclusions. Unfortunately I may have missed this due to General comment 2. a. I felt section 3.2 requires further information i. Where is the battery, ESCs, and other equipment located? Could this be incorporated into a Figure (Figure 3?) or added as a separate figure? ii. What

dies the background look like? The structural beam in Figure 1 doesn't have any steel in it? There is no change of the background over time? Or how did you handle the background removal? iii. You may want to add what gridding algorithm was used or if a filter was used. If an exact gridding algorithm was used without a filter, great job! iv. Why is there no signature from the motors? Or were they removed? v. What is the signature located in the tail seen in Figure 2b)? vi. P6, line 122. I do not understand why the flexibility of the wing from Tuck et al. 2018 would provide a limit on the flexibility of the wing of this UAV. vii. Could you use the same colour bar for a) b) and c) in Figure 2. viii. Two reference that would be well suited for this section: 1. (Hansen, 2018) – magnetically modelled a fixed-wing VTOL UAV. 2. (Tuck, 2019) – magnetically characterized 4 different UAVs using a motor setup

Specific comments: 1. The motors seem to have many names: "electric engines" (P1, line 10), "BLDC motor" (P4, table 1), "BLDC servomotor"(Figure 3 caption). Personally I prefer "BLDC motor" as I think of servo when I read servomotor and pistons (like a gasoline engine) when I read engine. As a result, I am confused whether 3b is the magnetic signature of a servo or the motor. As there are 4 of the former and 3 of the latter how does their signatures compare among each variant? (Forrester, 2011) suggest that the field produced by servos can vary significantly. 2. I could not find a reference to figure 3. 3. Are there tail servos? Where are they in figure 3? 4. P2. Line 38. Are traditional manned aeromagnetic surveys limited to above 80m? Can you provide a reference for this? I have seen helicopter mag surveys searching for UXO only a few metres off the ground. . . 5. P2, Line 39. I would suggest adding something about the improvement of detectability by 1/distanceˆ3. This is important! 6. P3, line 61. Tuck et al propose a method for characterization that incorporates both static and dynamic interference together by powering the motors during measurement. The "interplay" is relevant to how a source can influence other sources and so all systems should be active during characterization. Could you be clearer as to why you claim this experiment is still not sufficient? Also, you do not do this for your characterization experiment and should be explained why you chose to ignore this "interplay". 7. P3, line

71. Are the motor still powered during fixed-wing flight to keep the props from spinning? Or do they loosely spin during flight? Wouldn't either scenario provide interference? 8. P5, line 106 you say "The UAV remained turned-off during the magnetic signature measurement". 9. Sentence on P5, line 114-116 is not true. The noise envelope is not a function of the efficiency of compensation. 10. P7, line 137. It should be noted that although increasing the boom length may not create additional significant aerodynamic forces, it does increase instability during flight. Also, one would expect larger amplitude vibrations with a longer boom (P7, line 141). 11. P9, line 179. Are you suggesting that the magnetic geology 12 km deep created a gradient of 225nT/m? Later you say otherwise (p10, line 187) so I think you just need to reword this sentence. 12. P10, line 180. You suggest the interference is "probably due to radio transmission and cultural noise". You could test this by turning your radio on and off. You can test for cultural noise by moving the UAV to another area. 13. Figure 8. Why doesn't the 4th difference correlate between the two sensors if the source is mainly the UAV? Perhaps worthy of discussion? 14. P13, line 2. Will adding 10 cm to L make much of a difference? This can be calculated easily once you identify your source (which you do in the previous section). 15. P13, line 231. Either use relative time or do the math. Relative time looks cleaner. 16. P17, line 251. Why is the gradient higher for the second dynamic experiment than the first?

I have included more detailed comments in the attached scan.

References: Forrester, R. W.: Magnetic Signature Control strategies for an unmanned aircraft system, Carleton University, Ottawa, ON., 2011. Hansen, C. R. D.: Magnetic Signature Characterization of a Fixed-Wing Vertical Take-off and Landing (VTOL) Unmanned Aerial Vehicle (UAV), University of Victoria., 2018. Tuck, L.: Characterization and compensation of magnetic interference resulting from unmanned aircraft systems, Carleton University., 2019.

Please also note the supplement to this comment:

https://gi.copernicus.org/preprints/gi-2020-29/gi-2020-29-RC1-supplement.pdf

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