Comment on gi-2021-15

Anonymous Referee #1

Referee comment on "Analyze and reduction the influence of geomagnetic gradient on aeromagnetic compensation in a towed bird" by Zhijian Zhou et al., Geosci. Instrum. Method. Data Syst. Discuss., https://doi.org/10.5194/gi-2021-15-RC1, 2021

Review of "Analyze and improve the influence of geomagnetic gradient on aeromagnetic compensation in a towed bird" by Zhijian Zhou et al.

Overall:

This paper is about aeromagnetic noise compensation of a total-field magnetometer mounted in a bird towed by a helicopter. The paper suggests that the Tolles-Lawson noise model can be improved upon by introducing x,y,z position terms to the ridge regression solution. Overall the paper is interesting but I am uncertain if it is novel as the survey method has been around since the mid 20th century and introducing position terms has been around for just as long. I would ask that they highlight what is novel in this paper.

Their reasoning using analytical expressions makes sense but I believe could be made more concise. The use and reuse of certain variables is confusing. Their results presented do suggest reduced noise, although I think they could be a little more thorough. See comments below.

The paper needs a good rewrite. I find many sentences confusing and have to guess their meaning. I would recommend a major revisions.

Specific comments:

-some paragraphs are indented, other are not

-(line 23), its "Bickel"

-(line 39, 62, 73, 183, 203) contains a sentence that does not make any sense. These are just examples of many.

-(line 46 and throughout), I believe the better term is "ridge regression" not "ridge estimation"

-(line 56) can you support that the interference generated by the helicopter is small? Using the TL coefficients, can you estimate where the bulk of the noise of the bird is coming from? Ie permanent, induced magnetization or eddy currents?

-(Figure 3), was the diamond line data used in the results? If not, it should be removed. Or results should be added. I would prefer the latter as the results are sparse and barely convincing.

-(line 70) the altitude of the helicopter or bird was 1250m? Above ground or GPS height? (Above ground is really what matters). Why does line 143 say 1500m? How far below the helicopter was the bird? What is the std of the earth's field at this altitude? Or if the earth's field is the concern why wasn't the results collected at lower altitude close the ground where variations are greater?

-(lines 85-90) this can be better explained with a diagram, or amend figure 5, or just reference another paper that explains it. I believe leliak covers this well along with much of this section.

-(equation 2) remove the brackets

-(line 102) both matrices cannot be transposed for proper multiplication

-(line 100) reference 5 does not exist, references are not numbered. Also I do not agree that the 0.1-0.6Hz band is the typical interference band. Also sentence needs to be worded better.

-(line 121) explain why SVD is needed.

-(line 124) what is N? what is n?

-(equation 10) I believe there is an error in this equation when you substitute equation 9 into it. Sigma should be in the numerator

-(line 130) "large change range" requires more explanation

-(equation 11 and variables throughout) I would suggest changing the latitude variable to x. change all x variables to c or c_something because it is a coefficient. This will clean up line 167 where you have a mix-mash of variables.

-(equation 12) you reuse N and n, I would avoid this and just use different letters

-(line 136) Dawson and Newitt fit the components, not the horizontal gradient. They also used 6th order polynomial. Further explanation is needed as to why equation 11 is valid.

-(line 152) equation 14 has 3 dimensions, lat, long and z

-(line 161) equation reference 11 should be 14 I believe

-(line 198) why do you switch the filter bank to 0.03Hz specifically? After say the band should be 0.1-0.6Hz? Is the upper limit still 0.6Hz?

-(line 195) font size change

-what ridge regression coefficient do you use?

-(Figure 6) can you calculate the error on your IR calculations. Are you sure the differences are significant? Can you should the trend between N:1-6? Figure 6 should look like Figure 7. The caption should state the difference in results between Figure 6 and 7 because I am unclear why Figure 6 results are not included in Figure 7. Perhaps they should be combined? Regardless, further clarity is needed here.

-(line 213) what evidence do you have that the noise is a vibration mode of the towed bird? Or do you mean swing?

-(line 216) "greatly improved" may be an overstatement when looking at Figure 6. Or explain why.

-(Figure 7) Why remove N=2? Is the STD the compensated or uncompensated signal?

-(Figure 7) VERY IMPORTANT. Why is the S-N noise reduced so significantly for N=3 compared to N=1? Could this point towards a much better noise model? Or is something else going on here?

-(line 250/254, and other instances in the references) inconsistent naming of B.W. Leach. See other errors in the scanned copy. More thorough review is needed.

Please also note the supplement to this comment:
https://gi.copernicus.org/preprints/gi-2021-15/gi-2021-15-RC1-supplement.pdf