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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Principal Component Gradiometer technique for removal of spacecraft-generated disturbances from magnetic field data" *by* Ovidiu Dragoş Constantinescu et al.

Anonymous Referee #1

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This material is fully worth publishing as a working record of the cleaning of SOMAG magnetic field data. As an academic paper to discuss the technique which contributes to the better scientific results, I think, the authors have to revise it, at first, to distinguish the matter particular to the SOMAG case from the general matter.

Major comments :

1) The descriptions in section 2 should be considered, because they would be inadequate to explain the basics of the method proposed by the authors. The authors start with expressing the disturbances as the productions of dipole and quadrupole magnetic moments. However, the disturbance characteristic which makes the method described

in section 3 applicable is the linear independence at two sensor positions, and therefore disturbances are not necessary to be expressed by the magnetic moments. Although the magnetic moment model would be very useful to optimize the sensor positions and estimate the error, as author did in section 5 and Ness (1971) did, it is not essential to describe the principle of the method proposed by the authors.

2) Descriptions about general rule and requirements are mixed with those about specific conditions to SOMAG and author's assumptions. It makes the readers confuse what is universal to all magnetic field measurement with what is specific to author's case.

2-1) page 2 line 47, 'In many cases the direction of ...' I do not think it is often the case.

2-2) page 5 line 117, 'but does not change its direction' I do not think it is often the case.

2-3) page 6, line 157, 'For many spacecraft, including GK2A, artificial disturbances keep their direction fixed ...' I do not think it is often the case.

3) Many of equations in this paper are derived without enough explanation, and some of them seem to be incorrect.

3-1) page 3 lines from 70 to equation (8), this part is not understandable due to the shortage of the explanations.

3-2) page 3 line 73, what are k and l ?

3-3) page 3 line 79. 'The inverse ... ' Please explain the process to derive it. If (3X-I)^(-1) = (3/2 X-I), as authors say, (3X-I)(3/2X-I) = I. The left is 9/2 X^2 - 9/2 X + I, so it leads X^2 = X. Is it correct ?

3-4) page 4 line 84, 'and(5X-2I)^(-1) is equal to (5/6X-1/2I)' if so, again, X^2 = X. Is it correct ?

3-5) page 7, line 196, 'To eliminate the disturbance ...' this sentence is difficult to

understand. Please make it easy to understand.

3-6) page 17, equations (29a)(29b)(29c), Please explain how these equations are derived.

3-7) page 17, lines 388-399, It is not clear what Gˆs expresses (it cannot be the absolute offset), and how equation (31) is derived.

Other specific comments

4) page 3 line 66, 'Because higher multipole moment ...' Here authors say that they can ignore the contribution by higher degree moments. However, later they discuss under the assumption that one of the sensor pair is very closely located to the disturbance source, and therefore the contribution by higher degree moments cannot be negligible. Please make the descriptions consistent.

5) The proposed strategy to remove the noise argued in this paper seems to be inconsistent. In page 6, line 151, 'We now assume that one of the terms in Eq. (9) is much larger than the others. ...' In page 10 line 2, 'the placement of the AMRs close to the disturbances sources.' To do it, the authors should know the positions of the disturbance sources to locate the sensors nearby. It is inconsistent with the advantage of this method, 'allows the separation of disturbances generated by the spacecraft ... without prior knowledge about the positions of the disturbances sources. (page 5, line 134)' Please make it consistent.

6) page 9, line 232, '3-axis Flux Gate Magnetometer (FGM)...' Is the outboard sensor built based on the design by Primdahl (1979) and inboard one is based on Acuna (2002) ? If not, please refer the papers more adequately.

7) page 10, lines 263-268, I suppose that the sensing alignment relationship between the FGM and AMR sensors would significantly affect the result of the removal of the magnetic disturbances. Please describe the knowledge about the alignment relationship and its accuracy.

8) As for the March 4 case presented in this paper, magnetic disturbances are caused by multiple sources and they can be discriminated because the repetition periods are very different one another. The authors should discuss the condition regarding the repetition periods of the disturbances when the proposed method works well and when it does not.

9) The order of Figure 2 and Figure 3 should be changed since Figure 3 appears earlier in the text.

10) The meaning of the word 'orthogonality' in this paper is not clear. If it means linear independence, 'up to three independent, mutually orthogonal, simultaneously active disturbances can be separated using two sensors. (page 5, line 118)' would not be correct. More than three disturbances may be separated if they are linearly independent. The statement in page 14, lines 323-332 should be revised.

11) Page 17, section 4.3, What is the advantage to remove the disturbances by the onboard processor ? Because it cannot be guaranteed that the coefficients do not change for long period, it would be much better to determine the coefficients from the raw data on the ground.

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