EGUsphere, referee comment RC2
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Comment on egusphere-2022-293

Anonymous Referee #2

Referee comment on "Quad-Mag board for CubeSat applications" by Brady P. Strabel et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-293-RC2, 2022

General comments: An inexpensive and lightweight magnetometer concept is presented. Losses in quality compared to conventional instruments are explained in the preprint. The quality of the instrument is examined with comprehensible tests.

A very similar article was presented in 2018 as "Investigation of a low-cost magneto-inductive agnetometer for space science applications" at https://doi.org/10.5194/gi-7-129-2018. What is new here is that four sensors are operated simultaneously.

Stacking the four simultaneous measurements results in a halving of the expected data errors for statistical reasons. The four measurements at different locations on the circuit board would make it possible to identify interference fields generated by the device itself. (As differences in the measurements). The preprint does not go into this direction. But it is mentioned as an outlook ("undetermined blind source separation").

All in all his preprint is relevant and of interest for the community.

Specific comments:

In **chapter2** principles of magneto inductive sensing is explained. I found it hard to understand. The terms „driving the circuit with a positive (forward) or negative (reverse) voltage ...“ pussled me first. Reversing the supply voltage of a Schmitt trigger is in practice certainly not possible. Looking also at the PNI release notes of the PNI-11096 circuit I understand: Coil, resistor and Schmidt trigger form an oscillator, as properly explained in the preview. During this oscillation, the magnetic core material is driven into saturation. This reduces inductance and accordingly influences the oscillation period. The effect is advanced if the surrounding field is parallel to the field produced by the current in

the coil. It is reduced if thefield is antiparallel. The coil is reversed by means of electronic switches in the ASIC included in the RM 3100 and both periods are compared to produce readings of the field.

Chapter 4.2 Is it clear that the offset you measure between different sensors, are due to board-borne constant fields? Later on you state large sensor offsets. Can the sensors be swopped on the board to see if it are the sensors itself?

Chapter 4.4 Stability: You state in **chapter 4.2**: „The values of these offsets generally range from a few hundred nT to a few thousand nT, depending on the axis. In practice, the internal offset changes slightly after every power cycle of the sensor due to its digital components. As a result, the Quad-Mag board requires careful calibration if used for absolute field measurements." I think this is a stability item an should be mentioned there.

Technical corrections:

Introduction P1L15. The SWARM satellite mission uses three spacecraft to overcome just this problem.

P9L23: please better use the term „stacked" than „overlapped"

In the **Abstract** the last sentence says: The Quad-Mag enables 1 nT magnetic field measurements at 1 Hz using commercial-off-the-shelf sensors for space applications. Don't you think this is a bold statement seeing offsets of tenth to hundreds of nT at a single sensor and a resolution above 1nT in a zero Gauß chamber? How about „ The Quad.Mag allows for almost 1nT resolution under optimal conditions."