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Geoscientific Instrumentation Methods and Data Systems Discussions

# *Interactive comment on* "Possibilities of further improvement of 1-second fluxgate variometers" *by* Andriy Marusenkov

**Anonymous Referee #1**

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The paper "Possibilities of further improvement of 1-second fluxgate variometers ", by Andriy Marusenkov is a useful addition to the fluxgate magnetometer literature. It provides a case study for issues affecting fluxgate magnetometer performance, relative to the new INTERMAGNET 1-second standard, particularly sensor noise, and feedback current noise and stability. It deals primarily with the latter.

Overall the paper is thorough description of the case study, concise and to the point.

I have a few thoughts/questions/suggestions:

Page 2, lines 5-8 The described ring-core is relatively large with comparatively large magnetic material content. This added mass is a tried-and-true method for improving sensor performance. Cobalt is the typical primary material used in the best amorphous materials. A great deal more could be written here about the material and its process-



ing. I shall assume this is proprietary knowledge. That could be confirmed. It is long known that saturation induction or Curie temperature are both guides to noise performance. Would the author give guidance to readers by providing such data? If the Curie temperature is higher than 200C that would be welcome news.

The use of a fiberglass [and resin] bobbin implies the tape was heat treated prior to its assembly onto the bobbin as resin can't take the heat. The temperature stability of fiberglass is generally large and indeterminate, so that could hinder the collection of good data, at least at the very longest periods. Does the author propose using fiberglass bobbins in final designs?

The sectoral sense windings as described are difficult to imagine. Are they also used for feedback current? A photograph of the sensor would be helpful. If there are separate feedback windings their descriptions would be helpful too.

The drive field amplitude of 6800 A/m is huge. Was this difficult to achieve? The saturation fields of low noise ring cores can be a few 10s of A/m. Why so large a drive field? The 7.5 kHz drive frequency is fairly typical. Does the author have any thoughts about sensor noise vs drive frequency? Are there publications, either extant or planned, regarding the sensor development?

Page 2, line 28 "current-to-voltage converter" Is this correct?

Page 3, line 11 It may be worth mentioning that the buried Zener voltage reference has a long history in magnetometry, going back at least to MAGSAT's use of the LM199 diode at the time from National Semiconductor, and later from Linear Technology. I believe that MAGSAT was also the first instance of a DCCS used in a feedback.

Page 3, line 25. "Linear Technology Corp., 2015" By coincidence as of last Friday [2017/03/10] the company Linear Technology Corp. no longer exists, as it was acquired on that date by Analog Devices. If Analog Devices runs true to form the technical documentation under the Linear Technology banner will all disappear. For future readers of

this paper there should be a footnote or something that will guide the reader to Analog Devices for information regarding the LTZ1000 component.

Page 4, line 6 Generally DAC based DCCS's are competing with pulse-width-modulation based DCCS's. An example of the latter is found in: http://www.geosci-instrum-method-data-syst.net/2/213/2013/gi-2-213-2013.pdf , which is but one example of this strategy. The author's thoughts comparing these two approaches, would be welcome.

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