Thesis supervisor's review

Name of the student: Iurie Coroli

Title of the thesis:Low offset drift - low noise orthogonal fluxgate with synchronized polarity flipping

Grade proposed for the thesis: A – Excellent

The thesis presents a new type of magnetometer with extremely stable offset, at the top level in this class of instruments. The results included in this thesis will be shown at EMSA 2016 conference next month in Turin.

The student has worked hard to achieve this result. He has actively cooperated with the supervisor during endless sessions in the laboratory for the whole year.

The work of the student was focused on two main skills: first he learned how to design some basic electronic circuits and the related PCB as well as to manufacture them. During this period of time the student became independent in being able to read datasheet to find the needed information, to choose the proper components, to design the board and assemble them. Even if the complexity of the circuits was not extremely high, this experience in the lab was enough to rise the student from the I-have-never-soldered-SMDs!-I-have-no-idea-how-to-hold-a-soldering-iron level to the no-problem-I-am-gonna-do-it-myself level. Mission accomplished.

The second main skill was developing an approach to scientific investigation. During the development of this magnetometer the student had to face questions which still did not have an answer in literature. For instance, to which extend the switching of polarity introduced noise to the output signal in order to choose the best strategy for noise reduction. Therefore, the student was experiencing a simple example of research: he learned how to make the correct measurements (including the analysis of the obtained data) in order to obtain the needed information and how to interpret it. He gained experience in the lab becoming confident in the good-practice for avoiding possible mistakes in the experiments and artefacts.

The student was guided to understand how to set a theory and how to choose the proper experiment to verify it. From this point of view the student showed to be very receptive and promising. He was able to handle long discussions with the supervisor at the same level. He was able to criticize the ideas proposed by the supervisor (and also to be accidentally right, from time to time) as well as to propose his own ideas. If I really have to make a remark I would say he needs to be more patient, and not to necessarily expect immediate results.

In the original thesis it was planned to make a connection between the DDS board the student had developed during the winter semester to the flipping stage of the magnetometer. This part was

finally skipped because I preferred the student to focus more on the scientific part of the project, as the results were promising and I preferred to have him experience some example of research instead of developing an extra board. The results he obtained about the synchronization using waveform generator can easily be extended to the DDS board.

Finally, the student has both improved his practical skills in the lab as well as he has learned how to perform a simple task of scientific investigation. I suggest the commission to give him the grade A.

Košice, 13th June 2016

Ing. Mattia Butta, Ph.D.

České vysoké učení technické v Praze

REVIEWER'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name: Low offset drift - low noise orthogonal fluxgate with syncronized polarity flipping

Author's name: Iurie Coroli

Type of thesis : **bachelor**

Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.

The thesis focuses on the design and implementation of a novel method of operation of orthogonal fluxgate sensors for the measurement of magnetic fields compensating for the offset of the output signal induced by magnetic anisotropy and its time and thermal drift.
The manuscript spans from the basic physical principles of orthogonal fluxgate magnetic sensors to the most advanced engineering methodologies and systems combining digital signal processing, hardware implementation, code development and data analysis.

Formal and language level, scope of thesis **A - excellent.**

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

The formal notation across the whole thesis is correctly used and the language is clear and precise. Concept are expressed in a clear and effective manner allowing also to a not specialized reader to grasp the main concepts and ideas. The thesis is overall well written and readable.

Selection of sources, citation correctness **A - excellent.**

Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.

The cited references are all relevant and properly selected. The student and his supervisor demonstrate to have a wide vision of the field; the main results are clearly contextualized and distinguished from the existing ones. All bibliographic citations are complete and in accordance with citation convention and standards.

Additional commentary and evaluation

Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

The work presented in the thesis demonstrates the succesfull achievement
of the primary goal of the project. The main outcomes are original, with a high technical and theoretical content demonstrated by the use of advanced measurement methods, hardware systems and implemented softwares. The student demonstrates a solid theoretical background supported by a critical ability for data analysis and good operative skills. At the same time he has earned a mature working methodology.

České vysoké učení technické v Praze

REVIEWER'S OPINION OF FINAL THESIS

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation. Please present apt questions which student should answer during defense.

The main objective of the project is interesting and well planned. The manuscript guides the reader through this work from the basic physical concepts to the most advanced engineering methods and techniques. The problems and proposed solutions are clearly explained and well posed in the context of the state of the art methodologies. The final results are original with a strong impact in the field of magnetic field sensing. The thesis is overall a really good work and the evaluation is definitely positive.

Questions:

1) In a orthogonal fluxgate magnetic sensor the sensed field Hs is assumed to be constant or at a much lower frequency than the excitation field Hex; could the candidate give an estimate of the typical cut-off frequencies for normal applications?
Could the deviations from these values induced by external sources affect the compensation of the offset?

2) In the manuscript are explained the advantages of inverting both the I_{DC} and I_{AC} with respect to inverting the DC bias polarity. Could the candidate provide some additional detail?

3) In chapter 3 (Transient stability) is demonstrated how reducing the amplitude of the overshoot induced by the switching of the polarity of the sensor (through an adequate choice of the reference phase) is, in principle, not needed. How general is this results? That is, how does it depend on the specific physical characteristics of the magnetic core? Should the reference phase be specifically adjusted for each sensor?

4) In chapter 6 (Offset stability with varying temperature) is shown how fast thermal dynamics could affect offset stability, introducing sharp and relatively large deviations from the normal values (Fig. 35). Thermal conditions are an external variable which cannot be controlled a priori; should the sensor integrate any system to ensure thermal stability or additional signal processing of the output signal?

I evaluate handed thesis with classification grade A - excellent.

Date: 10-06-2016

Signature: