DESIGN OF A PCB-BASED VECTORIAL MAGNETIC FIELD SENSOR

Ping Hsun HSIEH[1], Shih-Jui CHEN[2,*],and Yean-Ren HWANG[3]

1) National Central University, Taoyuan City, Taiwan, 103383005@cc.ncu.edu.tw

2) National Central University, Taoyuan City, Taiwan, raychen@cc.ncu.edu.tw

3) National Central University, Taoyuan City, Taiwan, yhwang@cc.ncu.edu.tw

I. ABSTRACT

A PCB-based two-axis planar fluxgate magnetic field sensing system is presented. Through PCB fabrication procedure, the fluxgate sensor and lock-in amplifier circuit for signal detection were integrated together. The fluxgate sensor consisted of cross-shaped magnetic core, one excitation coil, and four sensing coils. The excitation and sensing coils were patterned in the opposite side of the circuit board with core pasted on it. The characteristic of the fluxgate sensor with respect to excitation signal was tested. Through the excitation signal optimizing, the fabricated two-axis fluxgate sensor showed nonlinearity below 5% in the range of 0-80 μT with 410 V/T sensitivity for the x-axis, and 436 V/T sensitivity for the y-axis, respectively. In addition, the sensing of vectorial magnetic field was demonstrated a great precision in both axes.

II. PRINCIPLE

The schematic diagram of the magnetic field sensor proposed is shown in figure 1. It consists of cross-shaped magnetic core, one excitation coil, and four sensing coils. With input AC signal in excitation coil, the alternate excitation magnetic field generated according to Ampere's circuital law causing the magnetic core saturated periodically. Due to the interaction with varying magnetic field, the induction voltage was emerged in sensing coil. Under the external magnetic field, the induction voltage of sensing coil was shifted. Through the difference of induction voltage, the sensing coils in the same axis were used to measure the external magnetic field.

III. CONCLUSION

In this paper, the integration of fluxgate sensor and lock-in amplifier circuit was successfully achieved by PCB technology. The fabricated magnetic sensor is shown in figure 2. By adjusting the parameter of the excitation signal, the performance of fluxgate magnetic field sensor had been optimized. Through the experiment result, the characteristic of the fluxgate sensor is shown in table I and figure 3. Furthermore, the component analysis of magnetic field is demonstrated in figure 4 shows a fine precision in both axes.

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Shih-Jui Chen
E-mail: raychen@cc.ncu.edu.tw
tel: +886-3-4267300

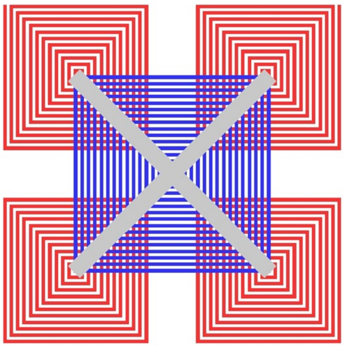

Fig. 1 Schematic of the fluxgate magnetic field sensor.

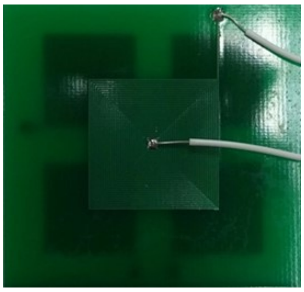

Fig. 2 Photograph of the fabricated magnetic field sensor.

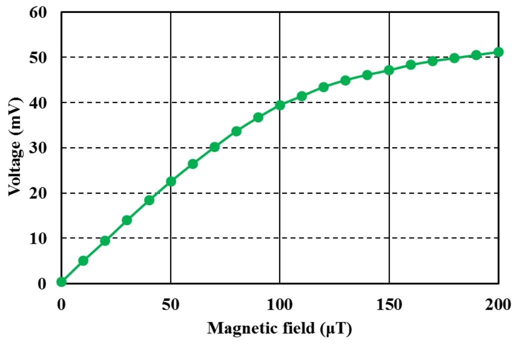

Fig. 3 Output voltage of fluxgate sensor in different magnetic field.

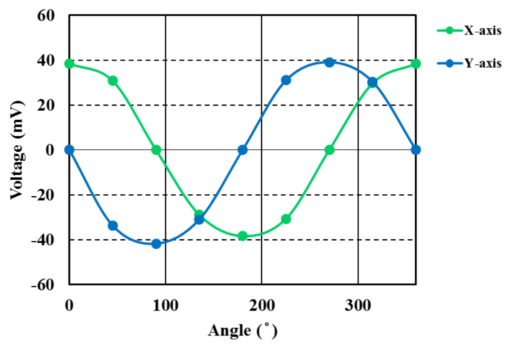

Fig. 4 The component analysis of magnetic field of 100 μT.

Table I Characteristic of the fluxgate sensor.

Excitation signal	50 kHz、0.75 A
Linear range	0-80 μT
X-axis sensitivity	410 V/T
Y-axis sensitivity	436 V/T