Development of the digital fluxgate magnetometer

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Fluxgate magnetometers have been used to measure three-dimensional DC components of the magnetic field. Fluxgate magnetometers developed to be onboard spacecraft typically have the accuracy of 0.01[nT] and dynamic range of +/-60000[nT]. They enable us to make highly accurate magnetic field measurement in the space and are expected to lead to new discoveries in the future missions. However, the sensitivity and offset of a fluxgate magnetometer often drift during the mission period and vary depending on the temperature. Therefore we must make more effort to design fluxgate magnetometers having more stable performance, and accurately calibrate the data when 1) we explore the planets far from the earth, 2) the temperature variation range of the spacecraft is large because of the large variation range of the distance from the sun, 3) high resolution measurement is required to study the micro process in the space plasma or to determine the intrinsic magnetic moment of the planets having weak magnetic fields. The conventional fluxgate magnetometer consists of the sensor part and the analogue electronic circuit part. Improving the electronic circuit part as well as the sensor would result in the better performance of the magnetometer. In some European missions after 1995 the digital processing circuit has substituted the conventional analogue electronic circuit. Adopting a digital processing circuit exclude the variation of the sensitivity and offset which would be caused by the changes of the characteristics of the parts in the analogue electronic circuit. In addition, due to the recent development of the IC technology, the digital processing circuit promises the advantage as for the mass and electric power consumption over the analogue electronic circuit in the near future. Therefore it is very important to investigate and develop a digital fluxgate magnetometer for the future missions. Today digital magnetometer is still under development and there is a little difference between the abilities of the digital and analogue magnetometers.

We have investigated a digital fluxgate magnetometer using digital signal processing technique. We have tested a bread-board model and found that it showed good performance. It indicates that a magnetometer whose performance is more stable than the previous ones will be realized for the space missions in the future. We intend to develop a digital magnetometer for future spacecraft using a FPGA. This time we present our investigation and development of a digital fluxgate magnetometer using A/D, D/A ,IO board and a personal computer.