Eb-P010 Room: Poster Time: June 11 11:00-13:00

Magnetic moment measuring system for satellite instruments

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For precise magnetic field measurement based on scientific satellite observation, EMC test is carried out in order to measure the magnetic moment of each onboard instrument, so that the magnetometer sensor's offset is below settled limits. We have done computer simulation experiment where we approximated each instrument's magnetic field distribution to a magnetic multipole and quantitatively evaluated the error. Hence, we have developed a new method of magnetic moment measurement that is more accurate than the present one. We have also constructed a new system for magnetic moment measurement. The main device of this system is a new non-magnetic biaxial rotational table. This system does not only increase the accuracy but also makes the EMC test easier to operate and less time-consuming.

For magnetic field observation, the magnetometer is installed at the end of a 5m extendible mast, in order to minimize the magnetic interference of the probe itself. Each onboard instrument undergoes the EMC test before the probe is completely assembled. The purpose of this ground test is to measure the magnetic moment of each instrument, so that the sensor offset would be under settled limits. It is necessary to determine the precise offset of the magnetic sensor to make an accurate analysis of the magnetic field distribution. At the EMC test, each instrument's magnetic moment is measured with a magnetometer settled 1m away. The offset is then estimated for the sensor installed more than 5m away from the probe, in order to deduct it from the observed magnetic field intensity. However, as the present method is handoperated, the whole process is time-consuming and lacks accuracy. By approximating each instrument's magnetic field distribution to a magnetic dipole or quadrupole, and summing them up, the entire probe's magnetic influence was estimated. However, for reasons mentioned previously, the estimated value has deviated from the actual observed one.

We have therefore developed a new method and device that make more precise analysis than the present one. We have simulated the instrument's magnetic field in a dipole, quadrupole and octupole approximation, and quantitatively evaluated each error. The measurement accuracy will augment as the order of multipole approximation gets higher. However, the analysis will be more complex as well. In addition, to ultimately determine the magnetic offsets of all loaded instruments, it is important to do multipole approximation to get enough accuracy.

The measuring device, which is under production consists of 3 parts. The first one is the "Non-Magnetic Biaxial Rotational Table" that provides information of the rotation angle. It is a newly produced device and is the core item of the total system. This rotational table has an accuracy of 0.5 to 1.0 degrees biaxially. The table rotates in both horizontal and vertical direction, with onboard instruments that are to be measured, settled on it. The second part is the "Fluxgate Magnetometer" that measures the magnetic field intensity in 3 components, and outputs digital data to the analyzing device. The last component is the "Magnetic Moment Analyzing Device". An analyzing computer program that was developed from the results of the simulation tests is installed. This enables us to make real-time analysis by recording simultaneously the data from the rotational table and the magnetometer.

The measurement takes place in the magnetic shield room, the magnetometer and the rotational table inside it. Onboard instrument is fixed to the rotational table with a belt, and its magnetic field intensity is measured while rotating the table. The analyzing device is installed outside the shield room. The rotation angle outputs and the magnetic field intensity outputs are both sent to the device and the magnetic moment of each onboard instrument is approximated to a multipole in semi-real-time. This system does not only improve the measurement accuracy but also meets the other demand of simplifying the EMC test operation and making it less-time consuming.

We have done computer simulation measurements of this system. The magnetic moment of the onboard instrument, which is assumed as the sum of multiple eccentric dipoles, is approximated to a magnetic dipole or quadrupole that is located at the center of the instrument. We estimated the difference of the magnetic field intensity measured at a point 5m away from the instrument. In the case of an instrument that consists of 4 eccentric dipoles, the maximum error was 5.2% of the true value for dipole approximation and 4.4% for quadrupole approximation.