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In orbit calibration of COTS AMR magnetic sensor

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Calibration of a vector magnetic sensor implies the determination of the three gain factors, the three offsets, the three Euler angles and the three non-orthogonality angles. This task is developed on ground and corrected with temperature when necessary, but the calibration is subject to non desired changes when a magnetic cleanliness program [1] has not been followed at mission level and the fully assembled spacecraft is exposed to medium to high magnetic fields.
In this work we report on a method for the in-orbit calibration of a commercial off-the-shelf anisotropic magnetoresistive (COTS AMR) magnetometer for the attitude control system of NANOSAT-1B spacecraft.

1. INTRODUCTION

The use of constellations of small satellites for topics as space weather is becoming more and more popular among the scientific community. One of the needed payloads on board such satellites is magnetic sensors. Since it is not always possible to deploy the magnetometers or to have a control on the magnetic parts of the satellites, a method to in-orbit calibrate the magnetic sensors can be very useful.
In this work we report on a method to calibrate a COTS AMR sensor on board NANOSAT-1B satellite of INTA. The nanosatellite consists in a single body and the magnetic sensor belongs to the Attitude Control System (ACS). In this case, the magnetometer is not deployed and it is exposed to the resulting magnetic field generated by the remanent magnetization of the satellite.
The COTS sensors have followed an upscreening process and they were in-orbit validated by a previous mission NANOSAT-01 [2,3].

2. FIRST STAGE: CALIBRATING THE OFFSET

The calibration process needs to determine the equation which gives the magnetic field as a function of the output values of the sensor [4]. In the case of NANOSAT-1B the experimental vector magnetic field needs to be calculated in the reference system of the satellite prior to be able to make any comparison.
The method to in-orbit calibrate the magnetometer relies on the fact that magnetic models (IGRF-11, WMM 2010.0) can be used to fit the experimental data to a good approximation (down to 10 nT, which is about the minimum detectable by these COTS sensors).
To do so, we firstly focus on the offsets error, the major expected change: a programme has been developed, based on iterative steps, checking those which best fit the model.
This work has been done with selected measurements in order to avoid external contributions and be able to focus on the calibration. The selected measurements are concentrated in August 2010 at mid-latitudes.
A common correcting offset has been found for all the measurements in this period, which minimizes the mean absolute deviation between the model and experimental data down to 160nT.
The work is fully useful for NANOSAT-1B attitude control system purposes. However, for space weather purposes, further work needs to be done with the fit of the other parameters of the calibration.

3. REFERENCES

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