Paper ID: 5468

38th STUDENT CONFERENCE (E2)
Student Conference I (1)

Author: Mr. Sebastian M. Ernst
TU Bergakademie Freiberg (TUBAF), Germany, info@s-m-ernst.de

APPLIED GEOMAGNETICS FOR ATTITUDE DETERMINATION EXPERIMENT (AGADE)

Abstract

The Applied Geomagnetics for Attitude Determination Experiment (AGADE) aims for analysing and comparing a set of different commercial of-the-shelf small 3-axis magnetometer assemblies as well as data analysis methods. The COTS magnetometers are launched together with a high precision magnetometer on-board a ballistic rocket. After the the flight, the resulting data is being used for evaluating ideas of advanced onboard magnetic field data analysis software, which could be used in pico satellites' attitude determination systems as well as in an experimental orbit determination system based on pattern recognition algorithms. The experiment's proposal was submitted to the German Aerospace Center (DLR) within the REXUS programme on January 6th 2008. In the end of April 2008 the experiment was finally chosen to fly on-board REXUS 6, which was launched on March 12th 2009. A detailed report is expected to be released by the end of June 2009. Finally, the experiment's set-up was developed by about nine students from the Freiberg University of Mining and Technology (TU Bergakademie Freiberg) and the Dresden University of Technology (TU Dresden) studying Geophysics, Electronics Engineering, Computer Science, Mechanical Engineering and Aerospace Engineering.

My field of interest

With the decreasing size of electrical devices and computers over the past years it has become possible to decrease the size of satellites as well. The standard allowing the smallest satellites is currently the cubesat standard with a limited mass of only one kilogram. This development caused the need for smaller ADSs. One possibility to determine a spacecraft's attitude is to use a known magnetic field such as the earth's one together with a reference model of it and to compare the determined field's orientation with the reference model's. Magnetometers are a typical payload for scientific satellites. If research is conduct on a celestial body its magnetic field is interesting almost every time. But in these cases the magnetometers are the payload itself or part if it. Compared to an ADS, the major difference is that a payload has an higher priority, its low mass is not as important as it is for subsystems around just fulfilling their basic tasks. Here the very small magnetometers become a topic of interest. If their results would be good enough it would be possible to build simple, small and lightweight ADSs. In fact this idea is not new and these days such small magnetometers are in use on a couple of small satellites, some of them build according to the cubesat standard. To the best of my knowledge the only reliable, freely available studies about these sensors' accuracy and behaviour in space are results of computer based simulations. In most cases an accuracy of 5 to 10 degree for attitude determination was reported for such sensors. Traditionally, the IGRF is simply used as a reference for this kind of measurements. An analysis of influences disturbing the measurements is sometimes not even considered. So, as a student of Geophysics, I found some kind of a vacant topic by applying knowledge from traditional exploration Geophysics, when I joined STARD. It is working on the SOMP cubesat. Later, my work on its ADS basically led me to the formation of the AGAD experiment. In case of AGADE I am working on data analysis, which means an detailed local magnetic field model of the rocket's flight path as well as an detailed model of the field disturbances caused by the rocket and its components. This analysis should lead to an conclusion of how far it is possible to go with such types of ADSs if there would be a much better reference. A further idea is to use the magnetic field sensors already included in ADCs to determine a satellite's orbit. This is possible due to the specific

shape of the earth's magnetic field. First simulations have shown, that this idea basically works – based on data collected over one low earth orbit – using some kind of pattern recognition and the IGRF as a reference. I am planing to conduct further research on this issue by using the gained knowledge of the sensor's data's characteristics.