Paper ID: 73838
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IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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THE LOW-COST ATTITUDE DETERMINATION AND CONTROL SYSTEM ASTER: DESIGN, TESTING AND LESSONS LEARNED

Abstract

The Attitude Determination and Control System (ADCS) of a spacecraft is often one of the most intricate subsystems, requiring significant resources to develop and integrate. An openly available ADCS platform for sounding rockets can make microgravity experiments more accessible, as development time and cost could be reduced. Project ASTER developed and tested such a solution. The main objective was to develop a low-cost and easy to manufacture system that enables future student teams and scientific missions with limited budget access to an experiment platform with a high-performance ADCS. The design utilises three reaction wheels, controlled by a closed-loop system, to stabilise a Free Falling Unit ejected from a sounding rocket within seconds. The platform would be able to perform slewing manoeuvres and accommodate future experiments in an easily adaptable payload bay. The design and testing results are being published on an open-source basis allowing further improvement, optimisation, and customisation.

ASTER was developed as part of the 13th cycle of the German-Swedish student programme REXUS/BEXUS and is scheduled to fly on REXUS-30 in March 2022. Due to the challenges faced by the project in the last phase of its development, the designed ADCS system will not be able to fly as an active payload on the REXUS rocket. The module will be assembled during the launch campaign without any active electronics, and the flight will serve to verify the retention system designed by the team for large Free Falling Units, as well as the mechanical low cost design solution of the high-performance reaction wheels. Although the final technical issues encountered by the team during the experiment reviews could not be resolved prior to the launch campaign, the verification of the aforementioned experiment subsystems in flight will be used to validate this initial design and enable further improvements. To offer a full qualification opportunity, discussions are ongoing to secure another flight opportunity as soon as possible. This would greatly help a second iteration of the project. The project has pushed a team of students to design a very complex experiment and has helped them gain experience in dealing with common issues and also failures faced in space projects. The paper will present the results from the REXUS campaign and the lessons learned from the overall project implementation and execution to help future student teams as well as the status of the additional flight opportunity.