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STUDENT CONDUCTED SATELLITE EXPERIMENT INVESTIGATING THE EARTH'S MAGNETIC FIELD AND AFFECT ON OPERATIONS

Abstract

The Technische Universität Berlin launched and operated a significant number of satellites in space. In 2017 the satellite TechnoSat was launched on a sun-synchronous orbit for the demonstration and verification of small satellite technology payloads. In the meantime, the mission objectives were achieved and the satellite made available for educational use. A project-based seminar course offered a group of students the opportunity to operate TechnoSat and to gain hands-on experience in satellite operation and mission planning.

The course aimed to simulate and thus provide first-hand experience on launch preparation, launch and early orbit phase (LEOP), commissioning of spacecraft and nominal operations of a real satellite mission. To prepare for the launch, the subsystems and the operations software were thoroughly examined using an EQM in the laboratory to enable the successful operations of the satellite through the LEOP after a simulated separation. Going forward, LEOP and commissioning were conducted on the actual TechnoSat flight model in orbit. During these phases subsystems and payloads were checked for functional integrity and performance. Finally, numerous experiments were planned and carried out on the flight model, and subsequently evaluated.

During a regular health an anomaly was detected while the satellite was located above the South Atlantic Anomaly (SAA). It is known for the SAA to affect internal computing processes and thereby having a negative effect on satellite operations when crossing this area. The occurrence of the on-board anomaly was the motivation for the TechnoSat "South Atlantic Anomaly Experiment" (SAAE) in which magnetic field sensors were used to measure the Earth's current magnetic field. For this purpose, the satellite recorded its attitude, position, and magnetic field sensor data every 16 seconds over a period of seven days. A contour map was generated using the data values. In addition, a damping experiment using TechnoSat's magnetic torquers around the SAA was designed to investigate the effects of the changing properties of the Earth's magnetic field upon the satellite's damping capacity. The data from these experiments was used, firstly, to verify TechnoSat's ability to measure the strength of the Earth's magnetic field and to locate the area of the SAA, secondly, to evaluate the effect of the SAA's physical conditions on TechnoSat's attitude determination and control system, and finally, to analyse the negative effects on satellite operations when crossing this area.