

IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)
Hands-on Space Education and Outreach (8)

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IMPLEMENTATION OF A SATELLITE OPERATIONS STUDENT PROJECT IN THE
MULTI-MISSION CONTEXT AT TU BERLIN**Abstract**

The Chair of Space Technology at the Technische Universität Berlin has successfully built and operated 16 satellites, with more to follow in the next years. The research facilities, projects and the rich academic environment provide students with the possibility to gather hands-on experience with satellites operating in orbit. Most of these missions exceed their design-lifetime thus offering potential for acquiring additional scientific and educational value. This paper shows how this potential is utilized by laying the operations of these satellites in the hands of students. A new, student-driven project that aims to educate other students in the operations of spacecrafts is introduced.

An overview about the chair's satellite missions is provided and key parameters for identifying missions suited for extended educational operations are discussed. The CubeSats BEESAT-2 and BEESAT-4 are identified and are used to illustrate the realization of this project. More of the chair's nanosatellites may be available in the near future, after they will have reached their mission objectives as well. Further, measures to provide these satellites for self-conducted student operations are identified by analysing the academic framework of these missions. This analysis is also taking into account the background of TU Berlin's funded student projects and legal aspects of operating satellites in amateur radio frequencies. Consequential challenges in the implementation process are discussed.

In the definition of educational and scientific objectives, undergraduate and graduate students with a background in aerospace engineering and related engineering disciplines are addressed. Undergraduates are encouraged to focus on space topics by working with finalized spacecraft in orbit. Master students gain the opportunity to increase their understanding of space systems by performing experiments in orbit and thereby contributing to scientific results. Following the analysis and along with the educational objectives, a curriculum for the project is composed. It consists of a one semester course to familiarize the participants with the available satellites and the chair's operating systems. With successful completion, students may obtain a licence from the chair for operating satellite passes independently. The course is tested with subjects until the final operating life test. Results are discussed and evaluated, also regarding the portability to other academic facilities.

Editor's note: A live satellite pass will be operated during the presentation, remotely controlling one of the TU Berlin stations. If no passes are available, operations will be demonstrated using lab models or video documentation.