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FROM CLASS TO SPACE:
A CAPSTONE COURSE FOR 4TH YEAR SPACE ENGINEERING STUDENTS

Abstract

This paper presents a Capstone course tailored for fourth-year space engineering students, providing them with an immersive, hands-on experience in the development of CubeSat missions. The course leverages space systems engineering principles to guide student teams through the entire lifecycle of a 2U CubeSat project, preparing them for real-world space missions. Students apply their learning to both conceptual and practical design, following key milestones such as Preliminary Design Review (PDR), Critical Design Review (CDR), and Assembly, Integration, and Testing (AIT).

In addition to the technical design and development of their CubeSat, students are involved in real satellite missions, including CUAVA-2 and the Waratah Seed satellite. These collaborations provide students with exposure to ongoing space projects, allowing them to contribute directly to mission planning and gain insights into industry practices. The hands-on nature of these projects allows students to refine their skills in system-level design, integration, and testing, ensuring they are well-prepared for future space engineering challenges.

The course incorporates a comprehensive testing phase, where students demonstrate their CubeSat using advanced test facilities, including a thermal vacuum chamber and air-bearing table, to simulate space conditions and validate system performance. The testing process emphasizes the critical importance of rigorous testing in space missions, preparing students for the challenges of spacecraft operation in extreme environments.

As part of the paper, several case studies of student-led CubeSat missions will be presented. These case studies highlight the practical outcomes of the course, showcasing how students have successfully applied the systems engineering approach to design, integrate, and test their CubeSat systems. Through this experience, students gain invaluable insights into the challenges and rewards of space mission development, while also contributing to the broader space exploration community.

By the conclusion of the course, students will have gained a strong foundation in space systems engineering, having worked on real satellite missions and developed a CubeSat mission from concept to physical demonstration. This Capstone course not only enhances technical proficiency but also equips students with the skills and experience necessary for success in the dynamic field of space engineering.