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Show Us Space: Demonstration of Hands On Education and Outreach (8)

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PROPOSAL OF AN EDUCATIONAL CURRICULUM UTILIZING THE CUBESAT SYSTEM EDUCATION KIT "HEPTA-SAT LITE" FOR LEARNING IN SATELLITE SYSTEM DEVELOPMENT

Abstract

This paper presents a novel educational curriculum using the CubeSat system education kit, "HEPTA-Sat LITE" designed for hands-on learning of satellite system development. Recently, CubeSat projects have gained prominence as on-the-job training (OJT) in the field of aerospace engineering. However, the project duration of about 1.5 to 2 years, making it difficult for students to learn the entire satellite system. Additionally, CubeSats are expensive. Therefore CubeSat projects pose significant challenges, especially for non-engineering students. In response to these challenges, the "HEPTA-Sat LITE" kit was developed with the goal of fostering a deeper understanding of satellites as systems and igniting passion for space exploration. In comparison to existing CubeSat education programs, "HEPTA-Sat LITE" stands out for its short duration (1 to 3 days), cost-effectiveness, and versatility, making it accessible to beginners without engineering backgrounds. The kit includes hardware, software, and texts for self-learning. University faculty and students with experience in satellite development provide advice as needed. The mainboard of "HEPTA-Sat LITE" is a palm-sized board (55mm × 55mm) with a microcontroller, battery, sensor devices, and communication equipment, closely resembling an actual satellite bus system. External power and signal interfaces are also incorporated. This simple configuration not only makes the satellite system easily understandable for beginners but also reduces manufacturing costs. The "HEPTA-Sat LITE" consists of six subsystems, including structure, power, command data handling, communication, ground station, and mission (sensor). It functions as an integrated satellite system. The curriculum follows a three-stage learning process: understanding components, grasping subsystems, and comprehending the system, incorporating both theoretical and hands-on approaches. Utilizing the signal interface, participants can easily implement additional components, allowing for missions involving rovers or multiple CubeSats based on their enthusiasm. This versatility makes the kit capable of addressing diverse objectives. The kit has been tested with high school students through a 1-day lecture, resulting in over 90% expressing newfound interest in aerospace engineering. Feedback revealed that experiencing mission design and development left the most significant impression on the participants. Thus, "HEPTA-Sat LITE" proves to be a kit that enables beginners without prior knowledge to understand satellite systems and deepen their interest in aerospace engineering. The work presented will use the pre-assembled HEPTA-Sat LITE to allow the audience to simulate satellite sensing and communications. Examples of missions using rovers and multiple HEPTA-Sat LITEs will be presented and demonstrated. No special technical requirements are needed for the demonstrations.