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ADVANCED ATTITUDE DETERMINATION AND CONTROL TESTING IN A MODULAR SOLUTION

Abstract

In recent years, the New Space Economy has spurred innovation among worldwide companies, particularly in CubeSat technologies, driven by the pursuit of cost-effective and flexible solutions. With competition intensifying, time has become a critical factor, especially in integrating and testing satellite subsystems.
To address these challenges, the project aims to implement, test and validate a modular ADCS software solution for the CubeSats application, using a modular avionics test bench to integrate the hardware required into a compact architecture. Thanks to a plug-and-play approach, this solution shall allow quicker and more efficient integration and validation of a modular architecture for one of the most crucial satellite subsystems, such as the **Attitude Determination and Control System** (ADCS). Following Modular design principles aims to increase flexibility by designing individual building blocks or modules, which must be interchangeable and adaptable to accommodate various mission concepts. A **modular avionic test bench** (MATB) has been used to create a unique and compact architecture, which integrates all the subsystems needed for the testing setup and for the mission scenario to simulate, from the Onboard Computer to the rate and attitude sensor and the attitude controller. In addition, specific simulation devices have even been added to recreate space environment features and supply external inputs to the chosen sensors. Furthermore, a **Hardware-in-the-loop** (HIL) simulation has been implemented to create an exchange of data between the integrated hardware setup and an orbital simulator, correctly modelled to provide data and measurements required by the ADCS software to be tested.
In conclusion, the outcomes of this work contribute to the advancement of CubeSat testing technologies by offering a versatile and cost-efficient solution for ADCS development that is not limited to this application. Moving forward, further research may be needed to extend even more the possible applications and implications that this technology could have in the future Space Economy, increasing the degree of accuracy that could be provided. Overall, the study underscores the importance of technology's evolution in improving testing methodologies and tools for space projects.