28th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Constellations and Distributed Systems (7)

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DESIGN SOLUTIONS FOR FORMATION-FLYING SAR SYSTEMS BASED ON MODULAR PLUG-AND-PLAY CUBESAT

Abstract

The exploitation of modular CubeSat as main platforms in high-performance Distributed Synthetic Aperture Radar (DSAR) systems can be a breakthrough for the future of small Earth Observation satellites. If, on one side, the distribution of SAR payload among several co-flying platforms, as in Formation-Flying SAR system (FF-SAR), enables to obtain high SAR imaging capability, from the other side, the modularity, applied to CubeSat platforms, allows to significantly reduce the whole timeframes for the development and launch, that means low-cost and easier access to space. As a consequence, the number of elements in the formation can be increased to have more acquisitions and improved performance. The goal of this work is twofold: to propose feasible solutions for the design of each modular subsystem, and to demonstrate that modular PnP CubeSat can operate as main platform in a FF-SAR mission. Indeed, the design is driven by both the need to make hardware and software components as more reusable as possible, in such a way to facilitate the readiness of using the same modules in different platform configurations for different mission scenarios, and also to ensure typical spacecraft operations as well as FF-SAR applications. For example, the Attitude Determination Control Subsystem (ADCS) software has been abstracted from specific sensors and actuators to allow the user to change either the type of ADCS hardware and its mounting location with no (or few) required further modifications. By standardizing hardware interface and by decomposing the single integrated ADCS software block in different single software components, only the appropriate software modules can be easily selected, when reused, based on available sensors and actuators. At the same time, FF-SAR multiple pointing modes required for SAR operations, as well as, attitude determination and control capabilities for the acquisition, reconfiguration and maintenance of the formation, must be ensured. To this end, a simulator developed in MATLAB/Simulink environment will be discussed in this paper to show the feasibility of this approach.