An approach for Assembly, Integration and Verification of a 6U CubeSat and the achievements of the ITASAT Project – IAA-LA-11-03

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Abstract

The purpose of this article is to present the ITASAT CubeSat Assembly, Integration and Verification (AIV) process with the 6U configuration of the ITASAT Satellite. This project is an initiative of the Brazilian Space Agency (AEB) to prepare human resources for space related projects inside the universities. The ITASAT CubeSat is composed by the service module (or platform) and the payload module. The service module shall provide the necessary conditions for the payload operation in orbit, such as energy generation and conditioning, data receiving and transmitting, on board data handling and so far. For this mission four experiments are planned to be tested in orbit: a Brazilian development of a data collection transponder (DCS Exp); a Brazilian development of a GPS receiver (GPS Exp); a COTS camera (CAM Exp); and a communication experiment with the amateur radio community (DCX1 Exp). The model philosophy adopted by the project makes use of an Engineering Model (EM) and a Protoflight Model (PM). This model philosophy together with the environmental conditions defines the test levels that the satellite undergoes during the verification process. One of the key points of the ITASAT CubeSat is the modular strategy employed during the development, integration and verification phases of the project. In this sense, the modularity represents the division of the system in small parts, self-contained, that can be assembled, integrated and verified independently. The integration or the exchange of one of these small parts of the CubeSat represents minor or no changes in other parts of the system. This modularity, which was also implemented in the software architecture and development, helps the AIV process once the assembly, integration, functional tests and verification were performed gradually and incrementally. For ITASAT project the satellite control center is located at ITA and the students will operate the satellite, so far, a man machine interface software have been developed (the satellite control software) and it allows to perform the "end-to-end" methodology test. The verification and validation of the satellite functions was based on blackbox tests of the satellite, which means the functionalities of the satellite were validated considering the sequence of operations expected to be executed in orbit, according to each operational mode of the satellite. The sequence of commands and corresponding telemetries simulating the environmental conditions and operational modes were used as main parameters to assure the validity of the test sequences and satellite validation. Environmental tests, specified by the launch provider were performed as well to assure that the CubeSat were able to stand the launch loads it will be submitted to. Besides the achievements of the construction of the satellite itself, some aspects are very important in terms of achievements of the ITASAT project: the first CubeSat allowed to train and to develop a qualified team inside ITA to work with embedded systems, especially for space application; the satellite development, assembly, integration and verification was performed

by the team composed by undergraduate and graduate students that are now able to share the experience with other university teams; the onboard software was integrally developed by the project software team; ITASAT is the first satellite to carry onboard a Brazilian attitude control software to be tested in orbit. As the result of the ITASAT project, there is a platform that can be adapted for a range of missions and it was created on ITA an expertise to work with embedded systems. An important item to emphasize is that based on this platform and the team expertise, partnerships have been agreed to start new missions at ITA.