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SPACE SYSTEMS SYMPOSIUM (D1)
Training, Achievements, and Lessons Learned in Space Systems (5)

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LESSONS LEARNED OF A SYSTEM ENGINEERING APPROACH FOR THE E-ST@R-II CUBESAT ENVIRONMENTAL TEST CAMPAIGN

Abstract

CubeSat-standard satellites have become more and more popular during last years. Education objectives, mainly pursued in the first CubeSat projects, have given way to the design of missions with other-than-education objectives, like Earth observation and technology demonstration. This new objectives require the development of appropriate technology. Moreover, is necessary to ensure a certain level of reliability, because education-driven mission often failed. In 2013 the ESA Education Office launched the Fly Your Satellite! Initiative devoted to provide six university teams with the support of ESA specialists for the verification phase of their CubeSats. Within this framework, the CubeSat Team at Politecnico di Torino developed the e-st@r-II CubeSat. E-st@r-II is a 1U satellite with educational and technology demonstration objectives: to give hands-on experience to university students; to demonstrate the capability of autonomous attitude determination and control, through the design, development and test in orbit of an A-ADCS; and to test in orbit COTS technology and in-house developed hardware and software (as UHF communication subsystem and software for on-board and data handling subsystem). The paper describes the application of a system engineering approach to the definition, planning and execution of environmental test campaign of e-st@r-II CubeSat and the gathered lessons learned. The approach is based on procedures designed and assessed for the vibrations and thermal-vacuum cycling tests of a CubeSat accordingly to ECSS rules and with the support of ESA specialists. Concretely, ECSS application, tailored to fit a CubeSat project, allowed to define a test plan oriented to reduce verification duration and cost, which lead to a lean verification execution. Moreover, the interaction with ESA thermal and mechanical experts represented a valuable aid to increase the Team know-how and to improve and optimise the verification plan and its execution. The planning encompasses the analysis of the requirements to be verified that have been gathered in such a way that the tests duration has been reduced. The required tests, like thermal-vacuum cycling and bake-out tests, have been combined in order to speed-up the verification campaign. The tests outputs shown that the satellite is able to withstand launch and space environment. Furthermore, satellite expected functionalities have been tested and verified when the CubeSat is subjected to space environment, in terms of temperature and vacuum conditions. In conclusion, it has been successfully demonstrated that the proposed approach allows executing a lean CubeSat verification campaign against environmental requirements following a system engineering approach based on ECSS.