

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

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E-ST@R-I EXPERIENCE: VALUABLE KNOWLEDGE FOR IMPROVING THE E-ST@R-II CUBESAT  
DESIGN

**Abstract**

Many universities in the world have now permanent hands-on education programs based on CubeSats. These small and cheap platforms are becoming more and more attractive also for other-than-educational missions, such as for example technology demonstration, science application, and Earth observation. This will require the development of adequate technology to increase CubeSat performance. Furthermore, it is necessary to improve mission reliability, because educationally-driven missions have 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 CubeSat. The project aims at increasing CubeSat mission reliability through several actions: to improve design implementation, to define best practice for conducting the verification process, and to make the CubeSat community aware of the importance of verification. Within this framework, the CubeSat team at Politecnico di Torino developed the e-st@r-II CubeSat as follow-on of the e-st@r-I satellite, launched in 2012 on the VEGA Maiden Flight. E-st@r-I and e-st@r-II are both 1U satellites with educational and technology demonstration objectives: to give hands-on experience to university students and to test an active attitude determination and control system based on inertial and magnetic measurements with magnetic actuation. The paper describes the lessons learned gained thanks to the e-st@r-I mission and how they have been used to improve the new CubeSat in several areas, from design to operations. The CubeSat design has been improved to reduce the complexity of the assembly procedure and to deal with possible failures on the on-board computer, for example implementing a new communication software in the communications subsystem. New procedures have been designed and assessed for the verification campaign accordingly to ECSS rules and with the support of ESA specialists. Different operative modes have been implemented to deal with some anomalies observed during the operations of the first satellite. The main difference is a new version of the on-board software. In particular, the activation sequence of the satellite has been modified to have a stepwise switch-on of the satellite. In conclusion, the e-st@r-I experience has provided valuable lessons during its development, requirements verification and on-orbit operations. This know-how has become crucial for the development of the e-st@r-II CubeSat.