Paper ID: 66799
oral

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Engineering - Methods, Processes and Tools (2) (4B)

Author: Dr. Paolo Lunghi
Politecnico di Milano, Italy

A NEW SYSTEM ENGINEERING TOOL TO SUPPORT AGILE DESIGN, IMPLEMENTATION, AND OPERATIONS OF NANOSATELLITES SPACE MISSIONS

Abstract

Nanosatellite missions are achieving even higher level of complexity as progress in miniaturization goes on. Born as simplistic systems with educational purposes, they are now capable of high quality scientific tasks. On the other hand, the time available for development still remains relevantly shorter then traditional space systems, spanning over a few years at maximum, compared to life cycles of even decades. This approach to the development poses new challenges: requirements definition, traceability, and verification must be rigorously ensured with traditional quality level, but with limited resources and personnel, in a reduced amount of time. Standard tools and software aides are often inadequate, for their high cost and steep learning curve, incompatible with the agile development and the small team size that characterize this new wave of space systems. To cope with such challenges, a new ecosystem of software tools was developed at Politecnico di Milano. The system core is a database, hosting all the information about requirements, tests, product tree, documentation, test facilities, and personnel. Parent/children relationship is exploited to ensure requirements traceability; verification activities are mapped on the requirements tree to continuously monitor the project verification status. Automated tests are performed to ensure data coherence, and to enable activities completion tracking. System budgets are computed automatically, data are crossed between different tables to aid System Engineering in scheduling and monitoring tests, avoiding inefficiencies and idle times. Relevant documentation, such as verification control, product tree, mass and power budgets is exported automatically in printable format. The system can be easily tuned to strictly adhere to specific normative (eg. ECSS) or to be completely tailored to the user needs. The HERMES Technological and Scientific Pathfinder mission is presented as use case: it is developed by the Italian National Institute for Astrophysics and PoliMi, coordinated by the Italian Space Agency, and financed by the Italian Ministry of University and Research and the EU H2020 program. It aims to continuously observe the celestial sphere in the γ and hard X-rays bands, looking for transient high energy phenomena (GRB) associated with gravitational waves, enabling multi-messenger astronomy. HERMES constitutes an exemplary application of the system: it envisages a constellation of 6 satellites, with very stringent requirements in terms of pointing, timing, positioning, and data volume, within a 3U-CubeSat form factor, 2 years in-orbit lifetime, and only 4 years available from concept to the launch of the first unit.