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SMALL SATELLITES FOR TELECOMMUNICATIONS AND SCIENCE MISSIONS

Abstract

Small satellite missions and constellations of small satellites have received considerable attention in the last few years. CubeSats, for instance, originally focused on educational projects are now considered by industry and space agencies as means to demonstrate and validate in orbit novel technologies at low cost and within short time scales. Internet giants like Google and Facebook are investing in constellations of small satellites to provide global Internet access. For professional missions key questions arise with respect to which performance and lifetime can be expected from a small, inexpensive spacecraft which utilises automotive-grade COTS components instead of space-qualified electronics. TU Graz has been successfully operating a nanosatellite for three years, called TUGSAT-1/BRITE-Austria. This spacecraft dedicated to measure brightness variations of massive luminous stars has been originally designed for a two year's mission, but current assessment of the spacecraft performance indicates that the mission can be extended by at least two more years. A remarkable achievement of the mission is that three-axis fine pointing could be consistently achieved below 1 arcminute. In this paper results of the long-term behaviour of the spacecraft with respect to power, attitude control, thermal and communications performance will be presented based on statistical analysis of the telemetry data collected since launch in February 2013. Within the framework of an ESA project, called OPS-SAT, radiation tests of critical subsystems of a nanosatellite have been performed, especially on a highly integrated processor based on a commercial system-on-chip module. The results are very encouraging allowing the use of low-cost, high-performance electronics components. As an example for advanced payloads, Ka-band transponders will be discussed which could be used for telecommunications missions as well as for inter-satellite links. Link budget calculations are included, demonstrating that high data rates can be supported even by a small power-limited spacecraft.