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DEVELOPMENT AND QUALIFICATION OF A LED-BASED PAYLOAD FOR A CUBESAT PLATFORM: LEDSAT MISSION

Abstract

LED-based payloads can offer improved optical tracking of small satellites by extending the observable interval from the time when the satellite is sunlit to the whole eclipse phase. LEDSAT (LED-based small satellite) is a 1U CubeSat mission aimed at demonstrating the capabilities of LED based boards to be installed on the external surfaces of small satellites. The nano-satellite will host 140 LEDs on all the six CubeSat faces. The satellite has been conceived by Sapienza University of Rome and the

University of Michigan and it has been integrated in early 2020 at the S5Lab at Sapienza University of Rome. The satellite project is participating in the ESA Fly Your Satellite! Programme and in the ASI IKUNS Programme. The LEDSAT LED flashing patterns have been optimized to enhance optical orbit determination, attitude determination and back-up light-based communication. Functional testing on the satellite will take place at Sapienza in March 2020, while environmental qualification of the satellite will be performed at ESA/ESEC Galaxia in Redu, Belgium, in Q2 2020. The launch is schedule for Q1 2021. The LED-based payload has already been qualified for spaceflight after undertaking radiation, UV, vibration and thermal vacuum testing between 2017 and 2019. LED long-range observations have been successfully completed by University of Michigan, through a high altitude balloon launch that observed LEDs at a distance of 54 km, and functional testing of the ground segment at approximately 10 km of distance by Sapienza University of Rome . All the AIV (Assembly, Integration and Verification) cycle phases have highlighted challenges and advantages of equipping LED-based payloads on-board small satellites. Furthermore, the lessons learned from the satellite payload design and integration are important for a future wider implementation of LED boards on-board small satellites with different missions and form factors. This paper describes the LEDSAT design and capabilities, especially the subsystems development, assembly, functional and environmental qualification. The satellite mission objectives will be outlined in the introduction. The CubeSat architecture will be described with a report on the satellite assembly. The completed functional and environmental tests for the LEDs and at system-level will be reported, with focus on the LED-based payload features, testing levels and testing campaign results. Applicability of LED-based payloads to other concepts and form factors of nano- and micro-satellite platforms will be outlined, with focus on the generalized usage of LED payloads for small satellite platforms.