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OPPORTUNITIES AND TECHNICAL CHALLENGES OFFERED BY A LED-BASED TECHNOLOGY ON-BOARD A CUBESAT: THE LEDSAT MISSION

Abstract

LEDSAT (LED-based small SATellite) is a 1-Unit CubeSat project conceived by the Sapienza – Space Systems and Space Surveillance Laboratory (S5Lab) research team at Sapienza – University of Rome, with the collaboration of the University of Michigan (USA). The project has been accepted for the European Space Agency Fly Your Satellite! Programme, it is under development with the support of the Italian Space Agency (in the framework of the IKUNS project) and it will be launched within 2020. The main mission objective is to test a payload composed of Light Emitting Diodes (LEDs) to verify and improve the current methodologies for orbit determination by means of optical data. The secondary mission objectives focus on testing LED-based methodologies for attitude reconstruction and on a basic light-based communication strategy. The implementation of a LED-based payload introduces a great number of technical challenges for the project. Indeed, the LED boards need to be qualified for being mounted on the outer surfaces of a satellite, for a Low Earth Orbit mission of one year. On this purpose, the research team has recently completed an Ultra-Violet radiation testing campaign and a gamma-ray Total Irradiation

Dose (TID) test to assess the diodes survivability to the space environment. Then, the design of a self-illuminating system requires to perform a trade-off between the LED activation time and radiated power, that increase the probability of detection from ground, and the available peak power and energy storage on-board the nano-satellite platform. Moreover, the spacecraft shall be able to autonomously manage the LEDs activation time synchronization with the Global Positioning System (GPS) time, in order to allow the observatories to coordinate the data acquisition to the LEDSAT flashes. Finally, a various set of photodetectors will be implemented at ground for testing the spacecraft LED-based communication. In particular, while a low data rate is suitable for simultaneously determining the satellite angular position and acquiring the down linked data with a Charge Couple Device (CCD), higher data rates can be offered by Avalanche Photo-Diodes (APD) or P-I-N diodes. The performance of these devices will be tested by the S5Lab research team in the next months. This paper describes the LEDSAT payload, the technical challenges related to its design and the implemented solutions for the spacecraft production. In addition to this, the expected outcomes of the mission and the possible applications of LED boards on nano-satellites will be discussed.