IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Technologies for Space Communications and Navigation (7)

Author: Mr. Andrea Gianfermo
Sapienza University of Rome, Italy, andrea.gianfermo@gmail.com

Dr. Giammarco Cialone
Sapienza University of Rome, Italy, giammarco.cialone@uniroma1.it
Mr. Paolo Marzioli
Sapienza University of Rome, Italy, paolomarzioli@gmail.com
Dr. Fabrizio Piergentili
Sapienza University of Rome, Italy, fabrizio.piergentili@uniroma1.it
Prof. Fabio Santoni
Sapienza University of Rome, Italy, fabio.santoni@uniroma1.it
Dr. Simone Pirrotta
Italian Space Agency (ASI), Italy, simone.pirrotta@est.asi.it
Prof. Patrick Seitzer
University of Michigan, United States, pseitzer@umich.edu

# LED-BASED OPTICAL COMMUNICATION ON A NANO-SATELLITE PLATFORM

**Abstract**

LEDSAT (LED-based small SATellite) is a 1-Unit CubeSat project equipped with a LED- (Light Emitting Diode-) -based payload, carried out by the S5Lab (Sapienza Space System and Space Surveillance Laboratory) research team. The satellite mission, conceived with the University of Michigan, has been accepted for the European Space Agency Fly Your Satellite! Programme and it will be launched in 2019. The project is primarily addressed at verifying and improving the current methodologies for satellites and space debris orbit determination by means of optical observations. One of the mission objectives relies in testing an encoded optical communication method to downlink basic telemetry data. This feature could support future CubeSats as back-up for traditional Radio-Frequency transceivers, providing redundancy and improving the reliability of these critical components. The LEDs are a promising payload for space communication thanks to their optimal performances in terms of radiated power and wide emission angle. While the high performances and small diodes dimensions allow to mount a high number of LEDs, sufficient to assure visibility from ground, on a small area of each satellite face, the wide emission angle allows a less strict on-board pointing requirement, which is usually a major constraint on a CubeSat. The light-based communication tests will be performed through three methods, at different data rates. The sidereal tracking method, consisting in shooting a long exposition picture to the target and acquiring its tracklet on a fixed stellar field, and the satellite tracking method, represented by the acquisition of a high frame rate video by maintaining the target in the field of view, will be exploited by means of a Charge Coupled Device (CCD). On the other hand, the high rate communication is achieved by using a telescope equipped with an amplified photodetector, able to convert the acquired light into an electric signal, thus allowing a faster flashes detection. The tests will be performed by the LEDSAT Ground Station network, which includes telescopes located all around the world, from the equatorial region (Kenya) to mid-latitude stations in both the hemispheres (Italy, USA, Switzerland, Chile). In order to decrease the background noise, telescopes are equipped with narrowband filters coupled with the LEDs wavelength emission. This paper will describe the LED-based light communication methods to be

tested on the LEDSAT 1-U CubeSat. In addition to the data link design, the potential outcomes and further applications of LED communication for CubeSat will be discussed.