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Author: Dr. Francesco Sansone
Italy

Prof. Alessandro Francesconi
University of Padova - DII/CISAS, Italy
Mr. Andrea Vettor
Italy
Dr. Riccardo Antonello
University of Padua, Italy
Mr. Francesco Branz
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy
Dr. Gian Paolo Guizzo
Italy
Dr. Roberto Corvaja
University of Padua, Italy
Mr. Edoardo Birello
Italy

TOWARDS IN-ORBIT DEMONSTRATION OF A COMPACT OPTICAL COMMUNICATIONS TERMINAL FOR SMALL SATELLITES

Abstract

In the last years, the need for optical communications systems for small satellites has risen as a consequence of the development of innovative commercial applications based on constellations of small spacecraft, often in the order of tens to hundreds of units. In particular, the advancements in the field of compact payloads for Earth observation (both optical, infrared and also SAR) and receivers for IoT and M2M services will lead to an exceptional increase of generation of spaceborne data in the near future. Fast availability of such data to the end-users is crucial for several applications including tracking of ocean vessels and aircraft, monitoring of dispersed assets, landmasses and forests, as well as real-time telecommunications. The use of optical communications for fast data downlink to ground stations and also satellite-to-satellite data relay will dramatically reduce the latency of sensitive data, with increased quality and profitability of the service.

In this paper, the authors present the development status of LaserCube, an optical communication terminal for small satellites that is currently on-track for an in-orbit demonstration mission.

The LaserCube terminal has a modular architecture based on a set of building blocks that can be arranged to realize a system optimized for satellite-to ground and inter-satellite communications. The system fits in 2 CubeSat units and can be embarked in platforms starting from the 6U form factor. It features a dual-stage pointing system that includes a dedicated coarse pointing mechanism for steering the optical unit and a fine steering mirror for microradian-level pointing corrections. The coarse pointing stage is based on a patented technology and offers a level of independence from the satellite attitude control system, whose performance can be relaxed. The system also includes laser sources for telecommunication and beacon purposes, which are optimized based on the scenario (satellite-to-ground or inter-satellite links).

The LaserCube technology has been validated through laboratory tests simulating operational scenarios

with realistic environment disturbances coming from the satellite bus and signal attenuation due to distance. Test results demonstrated unprecedented pointing accuracy and telecom performance: Gbps-level bitrate in simulated laboratory downlink scenarios, and bitrates of 100 and 10 Mbps over 1000 and 2000 km in simulated laboratory inter-satellite links scenarios. The in-orbit validation of the LaserCube-Downlink system is expected by Q1 2021.