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Author: Dr. Massimo Merenda
University Mediterranea of Reggio Calabria, Italy, massimo.merenda@unirc.it

Dr. Demetrio Iero
University Mediterranea of Reggio Calabria, Italy, demetrio.iero@unirc.it
Prof. Francesco Della Corte
University Mediterranea of Reggio Calabria, Italy, francesco.dellacorte@unirc.it

OPTICAL WIRELESS LINKS CHARACTERIZATION FOR INTRA-SATELLITE COMMUNICATIONS USING COTS DEVICES

Abstract

The spreading of adoption of CubeSats has paved the way toward Space to research and educational institutes and to small and medium enterprises, providing a standardized platform for developing low-cost missions. The adoption of CubeSats involves form-factor and budget constraints and, to this end, miniaturized Commercial off the Shelf (COTS) components are a good candidate for such projects, with reduced development, test and integration times and costs lower than their space-grade counterparts. Nevertheless, the miniaturization of equipment and platforms in Space systems is made possible by harness reduction. In fact, a satellite's harness account for 7-10In this work, a feasibility analysis on the replacement of data wires and connectors with optical wireless systems has been conducted. The main advantages of the adoption of an Optical Wireless Link (OWL) for Intra-Satellite Communications (ISC) are represented by the mass reduction, flexibility, and simplification of the assembly phase. The reliability of the proposed solution was further investigated. The usage of OWLs is conceived as a simple yet powerful communication system that does not require cable and connectors, allowing the bi-directional data transmission between different CubeSats after an in orbit docking. The system shows high performance in terms of band and geometric alignment tolerance, with the advantages of absence of physical conductors between the coupled units, an intrinsic immunity to radio interference, and assuring low costs in a very small footprint. The interface has been characterized by varying the distance between transmitter and receiver and the geometric operating tolerances have been identified using the Bit Error Ratio as the performance parameter. The paper provides a careful characterization of the system performances as it undergoes deep thermal cycling. A preliminary design and prototype is presented that meets basic space-flight requirements, offers data rates in Mbps range, and has completed basic proof-of-concept testing. The solution presented in this work strikes a useful balance among data rate, parts cost, and ease of use.