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TOWARDS THE SMALLEST INTER-SATELLITE TERMINAL

Abstract

The demand for higher data rates is on the rise in inter-satellite space communication. With the increased development of sub-CubeSat systems, a pressing need for the development of innovative optical communication solutions is growing. This paper aims to derive the requirements and constraints for the development of a miniaturised laser inter-satellite link (L-ISL) terminal for commercial and military applications.

Recently, optical laser-based communication systems have been implemented and demonstrated in orbit and in inter-satellite applications. These systems have superior performance metrics compared to the capabilities of radio frequency (RF) and microwave systems. As the number of small- and nanosatellites is exponentially increasing, future spacecraft networks require L-ISL terminals operating under more stringent size, weight, and power (SWaP) budgets compliant with the spacecraft and mission use cases.

This research builds upon a comprehensive literature survey on the state-of-the-art L-ISL systems, focusing on the critical aspects of the terminal SWaP requirements. The aim is to develop classes of miniaturised L-ISL, that bring value to identified spacecraft missions. First, a survey that encompasses a thorough analysis of existing research and developments in space laser communication technologies is presented, highlighting key advancements, challenges, and emerging trends. Additionally, a feasibility study of implementing L-ISL systems in picosatellite missions is shown, highlighting the trade-offs made for performance in view of miniaturisation for typical operation scenarios.

In the pursuit of optimising SWaP for picosatellite deployments, this work explores technological innovations and performance trade-offs associated with miniaturising L-ISL terminals. Emphasis is placed on identifying scalable solutions that strike a balance between SWaP constraints and the need for reliable, high-throughput communication capabilities. This study aims to provide a holistic understanding of the current landscape and analyse the viability of miniaturising a L-ISL for picosatellite applications.

The findings of this literature and feasibility research are expected to provide a system model for the future design and implementation of laser communication system for small satellites. As the demand for efficient and secure intersatellite communication grows, optimising L-ISL terminal SWaP for picosatellites becomes crucial for unlocking the full potential of these miniature platforms.