

IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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A NEW TYPE OF SATELLITE LASER COMMUNICATION SYSTEM UTILIZING COMMERCIAL
COMPONENTS

Abstract

Laser communication systems offer high-speed data transmission, immunity to electromagnetic interference, and the potential for secure communication. However, the cost and mass of such products for space are very high. With some Raspberry Pi boards being leveraged for their proven resilience in space environments, their cost-effectiveness, and low power consumption, efficient and effective systems can be built to provide promising solutions for space-based communication systems. This study proposes a refined, lightweight system that harnesses a Raspberry Pi board as the core component for the laser communication system and incorporates a laser diode for optical transmission. In addition, the system incorporates Low-Density Parity-Check (LDPC) coding and multiple modulation schemes to enhance data reliability, adaptability, and performance. The LDPC algorithm provides efficient error correction capabilities, mitigating the effects of channel noise and interference. Multiple modulation schemes, including On-Off Keying (OOK), Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Quadrature Amplitude Modulation (QAM) offer flexibility in adapting to varying channel conditions and optimizing data transmission rates. Through software implementation on the Raspberry Pi board, the system dynamically adjusts modulation and coding parameters based on real-time channel measurements, ensuring robust communication performance in diverse environments. Functional testing results demonstrate the effectiveness of the proposed laser communication system, highlighting its potential for high-speed, reliable data transmission for space applications, especially its suitability to be used for educational and small satellites due to its low cost, small size and lower mass compared to other available laser communication systems.