Abstract

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On-Board and Train-to-Wayside Free Space Optical Link: Design and Characterization

Nowadays, online connectivity has become an important factor in the current competition between different means of transportation. Being one of the most comfortable and satisfactory means of transportation, a train acts as a mobile office for a wide range of customers. This demands for a high speed connection in order to provide personalized digital services. A reliable and highly secure link is needed for real time information required for signaling, control, safety and security. In this paper a free space optical (FSO) communication link is designed, implemented, and tested at different data rates reaching 5 Mb/s. A small scaled link between train waysides and carriages is implemented in order to set the geometrical boundaries for a practical scaled up link. A 1 m train track is built in laboratory to set the track length and angle of transceiver boundaries for continuous transmission. The received signal voltage is measured and bit error rate (BER) is calculated along the track. The experimental results are compared to the ray trace model simulation results. The experiment is conducted with different field of view (FOV) light emitting diodes (LEDs) in order to check their impact on short and long distance links. Obtained results showed full train track coverage of 90 cm is achieved using the 13?-LED, where the 3?-LED was limited to 85 cm. A modification to the geometrical dimensions is suggested in order to suit the real train track. According to the designed circuits, a bandwidth can reach up to 337 Mb/s. At a speed of 500 kb/s, 9 m of coverage and nearly 38 m are obtained for the 13?-LED and the 3?-LED, respectively. On the other hand, at the maximum bit rate of 337 Mb/s, the coverage is reduced to 1 m and 5 m for the 13? and the 3?- LEDs, respectively.