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AN OPTIMIZED RATE ADAPTIVE DATA TRANSMISSION STRATEGY OVER HYBRID RF / FREE SPACE OPTICAL COMMUNICATION LINKS

Abstract

Wireless Free Space Optical Communication (FSO) has gained remarkable attention in recent years mainly due to its ability to transmit data reliably at tens of Gigabits/sec along with license-free deployment. However, FSO link is strongly affected by turbulent atmospheric conditions such as scintillation, fog and snow. This degradation in link margin leads to reduced link availability of less than 95% which is not acceptable for carrier-grade Telecommunication Infrastructure links. The RF communication on the other hand is quite less perturbed by aforesaid weather phenomena though it is affected by rain especially in GHz communication band. As each link is affected by different meteorological conditions, a significant increase both in the link availability and communication reliability could be achieved by combining RF and FSO technologies, thus forming a Hybrid RF/FSO communication link.

An FSO channel exhibits significantly higher data rate transmission capability at a lower cost compared to RF link in a clear-sky environment. An obvious hybrid channel operation strategy would be to use RF link as a backup link, activating it only if the FSO link fails. However this approach doesn't attain optimal utilization of both links since the RF link would remain idle for significant time intervals. So the effective way to use the hybrid RF/FSO channel is to encode the information data using a channel code that can utilize the diversity of both links by transmitting the data in a parallel fashion.

In this paper, an adaptive adjustment of information rate in a hybrid RF/FSO communication system is proposed. Besides adaptive symbol-rate transmission at fixed optical/RF power, it is shown that further improvements are possible with adaptive control of both symbol rate and transmit power.The hybrid RF/FSO communication channel is modeled such that each n-bit codeword is split into two streams of lengths **nr** and **no** bits to be transmitted on RF and Optical links respectively. The system varies the amount of symbols to be transmitted on each channel along with the symbol period and transmit power over a finite set of values depending upon channel state. Simulations are performed and results are compared to a non-adaptive system showing that a substantial performance gain in terms of average information bit rate and channel throughput is possible using the scheme mentioned in this paper.