Abstract

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Cooperative MIMO Techniques for Outdoor Optical Wireless Communication System

Free-space optical (FSO) communication has been the subject of ongoing research activities and commercial attention in the past few years. Such attention is driven by the promise of high data rate, license-free operation, and cheap and ecological friendly means of communications alternative to congested radio frequency communications. In most previous work considering multiple transmitters, uncorrelated channel conditions have been considered. An uncorrelated channel requires sufficient spacing between transmitters. However, this can be difficult and may not be always feasible in some applications. Thereby, this thesis studies repetition codes (RCs) and orthogonal space-time block codes performance in correlated log-normal FSO channels using intensity modulation and direct detection (IM/DD). Furthermore, the effect of different weather conditions on the average bit error rate (ABER) performance of the FSO links is studied. Multiple-input multiple-output (MIMO) FSO communication systems using space shift keying (SSK) modulation have been also analyzed. Obtained results show that SSK is a potential technique for spectral efficiencies equal greater than 4 bits/s/Hz as compared to RCs with multiple pulse amplitude modulations. The performance analysis of a multi-hop decode and forward relays for FSO communication system using IM/DD is also considered in this thesis. It is shown that multi-hop is an efficient technique to mitigate atmospheric turbulence and different weather attenuation effects and geometric losses in FSO communication systems. Our simulation results show that multiple-input single-output (MISO) multi-hop FSO systems are superior to direct link and MISO systems over links exhibiting high attenuation. Meeting the growing demand for higher data rates communication networks, a system with full-duplex (FD) relays is considered. For such a system, the outage probability and the ABER performance are analyzed under different turbulence conditions, misalignment error and path loss effects. FD relays are compared with the direct link and half-duplex relays. Obtained results show that FD relays have the lowest ABER and the outage probability as compared to the two other systems. Finally, the obtained results in this thesis are very promising towards the next generation of FSO systems.