DESIGN AND PERFORMANCE ANALYSIS OF OFDM-FSO SYSTEM USING POLARIZATION MODULATOR

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ABSTRACT

Free space optics (FSO) is a communication technology that makes use of free space for sending out optical signals between the two points. “Free space” refers to any unguided propagation medium like air, outer space or even vacuum. FSO is widely used in biomedical applications, underwater communication, campus connectivity, for establishing redundant links in case of an emergency or disaster, broadcasting, etc. Although, FSO has got many advantages but the link performance is deteriorated primarily by the atmospheric conditions such as fog, haze, smoke, aerosol, turbulence and the presence of pointing errors. While sending data through FSO link, the main challenge faced by the engineers is the atmospheric attenuation caused due to absorption and scattering processes. One of the most dominant factor which effects the propagation distance and reliability of the FSO link is fog. OFDM has proven to be a reliable modulation scheme to be used in FSO because of its ability to minimize the multipath fading due to atmospheric turbulences as data is distributed over number of orthogonally spaced carriers. Polarization Shift Keying Modulation (PolSK) is a good choice for FSO systems because the depolarizing property of the atmospheric channel is very weak and the SOP can be well detected at the receiver even after long-distance propagation. So, PolSK modulation has proven to be a reliable modulation scheme to be used for FSO systems.

OFDM-FSO System using Polarization Modulator is proposed where the output of OFDM transmitter is fed to Polarization Modulator and then launched into atmosphere. Using Circle Polarization Shift Keying Modulation, the requirement of polarization coordinate alignment is cancelled and the complexity of the system is reduced. The data is transmitted as two rotation states of circle polarization. The proposed system is found to have increased FSO link distance under different atmospheric conditions. Simulations are done using OptiSystem Software and it has been observed that using the proposed system, the FSO link distance is increased by 48.17%, 30.89%, 23.78% and 20.3% under clear weather, haze, moderate fog and heavy fog respectively as compared to conventional OFDM-FSO system. By designing Laser driver circuit for the proposed system using OptiSPICE, the FSO link distance is further increased by 31.11%, 21%, 16.6% and 14.03% under clear weather, haze, moderate fog and heavy fog respectively. The proposed system is found to support higher bit rates at comparatively longer distances. At 10 Gbps, for FSO link of 75 km with attenuation of 0.2 dB/km, Q-Factor of 8.144 is obtained with BER of 1.9×10-16 using the proposed technique. Whereas the conventional OFDM-FSO system achieves Q-Factor of 3.69 only with BER of 0.00011.