Abstract

Due to its many uses in areas like as communication, medical, LIDAR, laser scanners, the military, entertainment & enjoyment, and others, LASER is immensely popular in the current world. Free space optical communication can be formed and data sent successfully using LASER sources. Free space optical (FSO) communications are a low-cost, high-bandwidth access method that are gaining popularity due to its recent commercialization. This system's dependence on the atmosphere is its fundamental flaw. The system's performance has suffered in scenarios with bad weather.

In this thesis, cost effective FSO Communication channel has been established using different wavelength Laser sources like visible (532 nm, 638 nm), IR (808 nm, 980 nm, & 1550 nm). In this study, the primary atmospheric problems including fog, rain, and scintillation are taken into account. To evaluate the system performance in the aforesaid atmospheric conditions, some artificial atmospheric chamber has been developed in the laboratory. The unique aspect of this study is that the data from the artificial atmospheric chamber were created while taking Indian atmospheric conditions into consideration. Data from Indian weather reports were utilized in this.

The performance investigation of various wavelengths of laser sources under simulated weather circumstances has been done using a number of parameters, including optical power, real-time eye patterns, Signal to Noise ratio, Bit Error Rate, etc. According to the experimental findings, the optical beam attenuation has been observed to be more attenuated in foggy weather than in other atmospheric anomalies. Another significant finding from these tests is that, in the case of scintillation and fog, the performance of the FSO communication system is wavelength dependent, however in the case of rain, the optical power attenuation for various wavelengths is practically same.

For system performance enhancement, the techniques of wavelength diversity and aperture averaging have been proposed and integrated. Aperture averaging has improved system performance in terms of SNR, BER, real-time eye patterns, and optical power attenuation in different atmospheric conditions with irrespective of wavelengths, as shown by the wavelength diversity scheme, which shows that 1550 nm Laser performs better than other considered wavelengths. Finally, a theoretical link performance study for MWIR Laser sources at 4000 nm has been presented and compared with 1550 nm Laser sources at larger link distances (4 km). These analytical findings show that 4000 nm is more successful than other wavelengths under challenging air conditions. This work might lead to new developments in the field of FSO communication.