# DESIGN AND IMPLEMENTATION OF MOBILE FREE SPACE OPTICAL COMMUNICATION SYSTEM

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## Introduction

Free Space Optical Communication (FSO) offers highly directional, high bandwidth communication channels, especially in avionic application. Its links can provide fiber-like data rates over short distances with low probability of interception [1]. It also provides last mile solutions in many of today static communication system substituting wired or microwave system [2-3]. In our FSO systems, as the platform is mobile, it needs a much more robust tracking system than those used in fixed system to combat high-rise buildings sway. The sensor used in the tracking system is a quadrant diode; this means that transmitted beam needs to be small enough to be tracked by the sensor. Compared to other low cost systems such as those developed by twilight labs [1], our approach of using simple electronics and use of Complex Programmable logic device (CPLD) for the digital circuit decreases the size and power consumption of the system as well as reducing cost.

The proposed mobile free space optical communication system is a full duplex optical connection between two computer systems. The computer connects to the optical system via base-10 Ethernet; the optical system then encodes the digital data into an optical beam. On the receiver end, a beam splitter is used to split the beam into two, one beam enters the communication system that coverts the optical data back into electrical data, and the other beam enters optical position detector to control the tracking system. The tacking system is built and intergraded with the communication system. The entire system with transmitter, receiver, microcontroller and tracking system, is expected to consume less than 10 watts of power and weight less than 2 pounds. The use of servos means that moving portions of the system must weigh as little as possible to enhance mechanical performance. Fig. 1 is the simulation of optical link performance. Fig. 2 is the simulation results. The final performance of the signal versus distance is shown in Fig. 3 for laser diode (LD) FSO system. The preamp output amplitude shows a decreasing trend over distance, this is a function of both atmospheric absorption and beam divergence. The data clear indicate the 50m transmitter capability of our mobile FSO system, which is limited by the testing space. Finally an Ethernet link test is performed. We receive a clear link established signal. Then we send out a packet. The results of the FSO Ethernet testing will be presented.

## Conclusion

We explore the possibility and challenges of designing a mobile FSO system for remotely operated platforms. Therefore low power and light weight are essential qualities. The paper demonstrates a 10MHz mobile FSO communication with low power consumption, light weight and low cost. The system is mounted on a mobile platform with the battery power. We realize arbitrary signal transfer at 50 meters, design the tracking system using beam splitting technique, and successfully interfaced to Ethernet for a packet transmission. LDs and light-emitting diodes (LEDs) are used respectively in the transmitter design and be compared on the system performance. The LD transmitter consumes 600mW of total power, and outputs 15mW of optical power, which is better than that of the LED-based system.

**978-1-4244-1920-3/08/$25.00©2008 IEEE**

## Acknowledgements

This work was sponsored by the Department of the Navy, Office of Naval Research, under Award # N00014-07-1-1152.

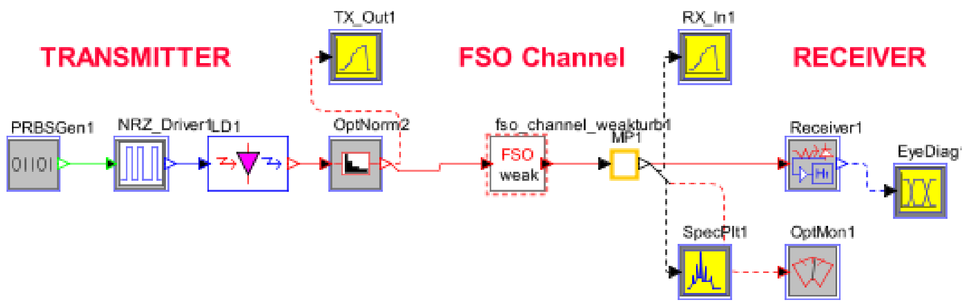



Fig. 1 FSO communication link simulation

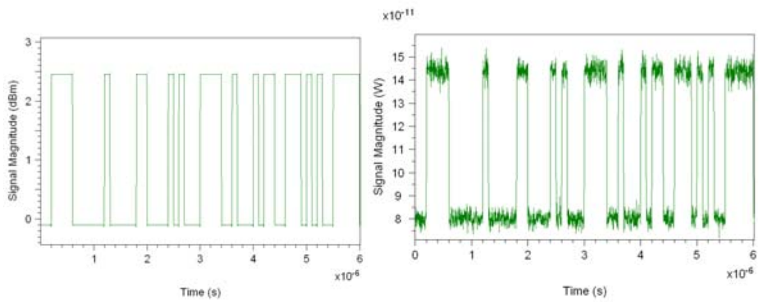
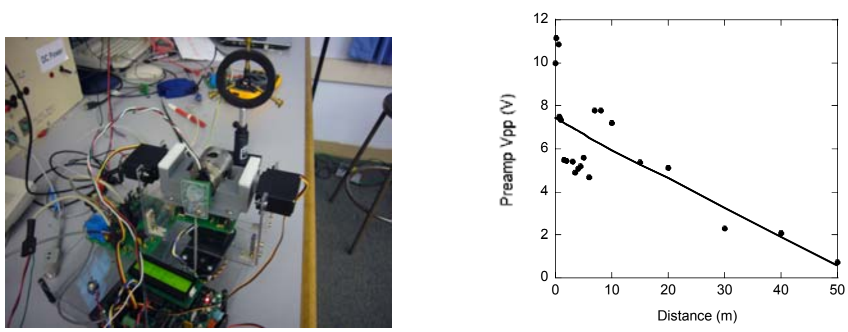



Fig. 2 FSO link simulation results (a) Transmitter signal and (b) Receiver signal.




(a) (b)

Fig.3 (b) The tracking system experimental setup, which consist of 3 servo motors, a quadrant diode based position sensor, a beam splitter, and a micro-processor control board; (b) Signal amplitude output versus distance for laser diode system.

## References

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