International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 11 | Nov 2018 www.irjet.net p-ISSN: 2395-0072

Under Water Optical Wireless Communication

RPVG Ashok Reddy[1], J Rajani Kanth[2], D Muneendra

[1,3]Assistant Professor, Dept of ECE, SIETK, Andhra Pradesh, India
[2]Associate Professor, Dept of ECE, SIETK, Andhra Pradesh, India

---

Abstract - *Underwater absorption, scattering and turbulence processes will introduce attenuation and fading to light propagation and then degrade the performance of underwater wireless optical communications (UWOC). As power consumption is an important issue in under- water missions, it is fundamental to minimize the intensity loss by reducing the beam divergence , data transmission in relatively high turbidity waters appeals for the use of energy-efficient modulations and powerful channel codes at the physical and data link layers. The particular difficulty of developing such model resides in the fact that turbulence highly depends on the operational scenario and also on the water conditions underwater wireless optical communications (UWOC), pulse modulation technique has been widely used due to the high optical power efficiency and relatively low system complexity. Compared with the simplest on-off keying (OOK) scheme, digital pulse interval modulation (DPIM) improves both power efficiency and error performance and requires no symbol synchronization. Polarization shift keying (Polk) is another appropriate modulation scheme which can effectively restrain background noise. A scheme named, polarized DPIM (P-DPIM) and Po1SK , combining both to further improve the performance, and deriving its bit-error- rate (BER) expression in additive white Gaussian noise (AWGN) channel. UWOC channel suggest that P-DPIM scheme can improve both the power efficiency and error performance as well as communication distance compared with traditional PPM and DPIM schemes.*

Key Words: Underwater wireless optical communications (UWOC), pulse modulation technique, digital pulse interval modulation (DPIM), on-off keying (OOK) scheme, polarized DPIM (P-DPIM), Polarization shift keying (Polk).

1. INTRODUCTION

An optical fiber (or fibre) is a glass or plastic fiber that carries light along its length. Fiber optics is the overlap of applied science and engineering concerned with the design and application of optical fibers. Optical fibers are widely used in fiber-optic communications, which permits transmission over longer distances and at higher bandwidths (data rates) than other forms of communications. Fibers are used instead of metal wires because signals travel along them with less loss, and they are also immune to electromagnetic interference. Fibers are also used for illumination, and are wrapped in bundles so they can be used to carry images, thus allowing viewing in tight spaces. Specially designed fibers are used for a variety of other applications, including sensors and fiber lasers.

In fibers, there are two significant sections – the core and the cladding. The core is part where the light rays travel and the cladding is a similar material of slightly lower refractive index to cause total internal reflection. Usually both sections are fabricated from silica (glass). The light within the fiber is then continuously totally internally reflected along the waveguide.

When light enters the fiber we must also consider refraction at the interface of the air and the fiber core. The difference in refractive index causes refraction of the ray as it enters the fiber, allowing rays to enter the fiber at an angle greater than the angle allowed within the fiber as shown in the figure.

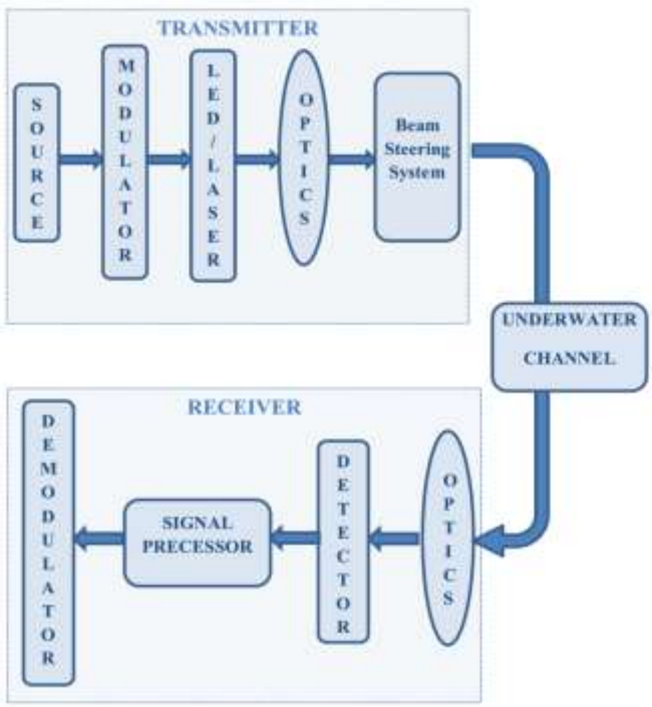
An optical fiber transmission link comprises the elements as shown in fig. The key sections are a transmitter consisting of a light source and its associated drive circuitry, a cable offering mechanical and environmental protection to the optical fibers contained inside, and a receiver consisting of a photo detector plus Amplification and signal- restoring circuitry. Additional components include optical connectors, splices, couplers or beam splitters, and repeaters. The cabled optical fiber is one of the most important elements in an optical fiber link.

2. OPTICAL WIRELESS COMMUNICATION

Optical wireless communications (OWC) is a form of optical communication in which unguided visible, infrared (IR), or ultraviolet (UV) light is used to carry a signal.

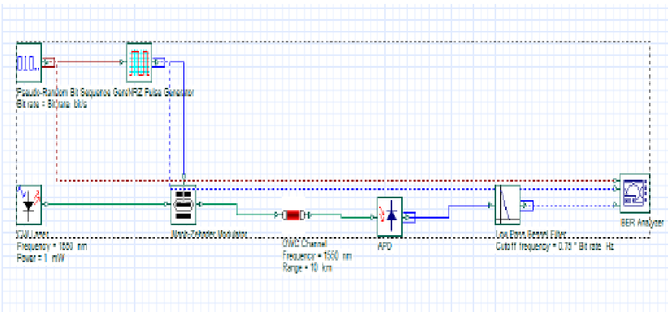
OWC systems operating in the visible band (390–750 nm) are commonly referred to as visible light communication (VLC). VLC systems take advantage of light emitting diodes (LEDs) which can be pulsed at very high speeds without noticeable effect on the lighting output and human eye. VLC can be possibly used in a wide range of applications including wireless local area networks, wireless personal area networks and vehicular networks among others. On the other hand, terrestrial point-to-point OWC systems, also known as the free space optical (FSO) systems, operate at the near IR frequencies (750–1600 nm). These systems typically use laser transmitters and offer a cost-effective protocol-transparent link with high data rates, i.e., 10 Gbit/s per wavelength, and provide a potential solution for the backhaul bottleneck. There has also been a growing interest on ultraviolet communication (UVC) as a result of recent progress in solid state optical sources/detectors operating within solar-blind UV spectrum (200–280 nm). In this so-called deep UV band, solar radiation is negligible at the ground level and this makes possible the design of photon-counting detectors with wide field-of-view receivers that increase the received energy with little additional background noise. Such designs are particularly useful for outdoor non-line-of-sight configurations to support low power short-range UVC such as in wireless sensor and ad-hoc networks.

3. Block Diagram



4. Simulation Set-up and Results

The simulation is done using OptiSystem Simulation Software. OptiSystem is a thorough programming outline suite that empowers to arrange, test, and rebuild optical connections in cutting edge optical systems. Propose algorithm comprises of a transmitter with RZ signals, wireless optical channel, optical receiver consisting of PIN photodetector, Bessel filter and BER analyzer to analyze the yield result. The biggest challenge for underwater wireless communication originates from the fundamental characteristics of ocean or sea water; addressing these challenges requires a thorough understanding of complex physio-chemical biological systems. So as to investigate the effect of nonlinearities on the optical communication system, the transmission distance of the optical system is differed.



The length of the wireless optical channel is differed. To produce the optical signs we have utilized a CW laser source, Mach-Zehnder modulators, RZ signal generator and a sinusoidal electrical sign generator.

Table1: Simulation Parameters

Parameters	Values
Bit Rate	40 Gbps
Modulation	RZ
Distance (km)	10, 20, 30, 40,50 km
Power	1 mw
Wavelength	1550 nm

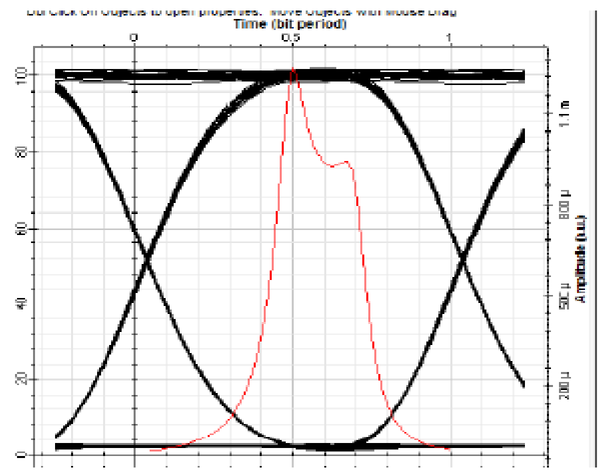
4. Results & Discussion

We have simulated the optical link working at 10 Gbps. The nonlinear effects are analyzed in terms Q Factor, BER with the use of Eye Diagrams. Following table shows the impact of nonlinear effects on the Q-factor in accordance to the increase in transmission distance for RZ modulation.

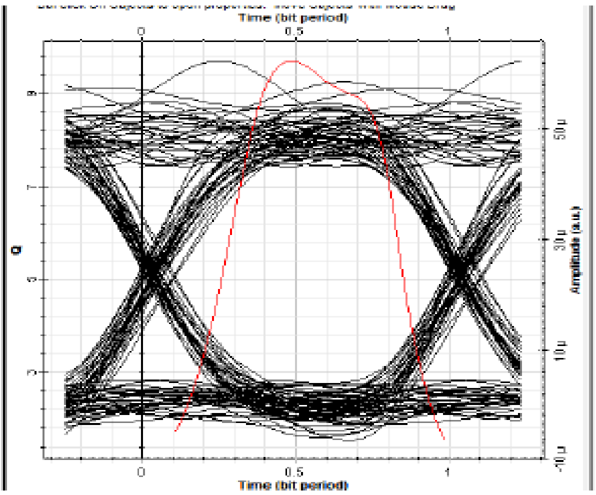
Table2: Q Factor Vs Distance

Factors	Distance (Km)				
	10	20	30	40	50
Q-factor	102.25	42.7 4	22.5012	14.2636	9.7028
BER	0	0	1.9E- 112	1.79E- 46	1.14E- 022

The below figures (a) & (b) shows the eye diagram of the link at 10 km and 50km respectively.



(a) Eye diagram @ 10 km distance



(b) Eye diagram @ 50 km distance

It can be seen from the result that as the distance increases the output in terms of Q-factor and eye diagram decreases.

5. Conclusion

As power consumption is an important issue in under- water missions, it is fundamental to minimize the intensity loss by reducing the beam divergence , data transmission in relatively high turbidity waters appeals for the use of energy-efficient modulations and powerful channel codes at the physical and data link layers. In this paper underwater wireless optical link is generated using optisystem software. The link is simulated for 10 km to 50 km and the distortions are taken into consideration. It can be seen from the result that as the distance increases the output gets more distorted. The output is better at 10 km compared to 50 km in terms of Q-factor, Bit Error Rate and eye Diagram.

6. References

[1] Chadi Gabriel, Mohammad-Ali Khalighi, Salah Bourennane, Pierre Le´on, Vincent Rigaud – "Investigation of Suitable Modulation Techniques for Underwater Wireless Optical Communication" Published by-IEEE.ISSDN No.:978-1-4673-2733-6,2012.

[2] Mohammad-Ali Khalighi1, Chadi Gabriel, Tasnim Hamza, Salah Bourennane. Pierre Le´on, Vincent Rigaud. —"Underwater WirelessbOptical Communication; Recent Advances and Remaining Challenges", Published by-IEEE. ISSDN No.: 978-1-4799-5601-2, 2014.

[3] Hai-Han Lu1, Chung-Yi Li1, Hung-Hsien Lin1, Wen-Shing Tsai2, Chien-An Chu1, Bo-Rui Chen1, and Chang-Jen Wu1, —"An 8 m/9.6 Gbps underwater wireless optical communication System" , Published by- IEEE,2016.

[4] Yuhan Dong, Jinxing Liu — "On BER Performance of Underwater Wireless Optical MISO Links under Weak Turbulence" published by- IEEE ISSDN No. : 978-1-4673-9724-7, 2016.

[5] Xuelong Mi and Yuhan Dong — "Polarized Digital Pulse Interval Modulation for Underwater Wireless Optical Communications", published by-IEEE,ISSDN No.: 978-1-4673-9724-7 ,2016.

[6] Xifeng Li, Xinsheng You,,Meihong Sui, —Evaluation of Underwater Wireless Optical Communication Link with Pspice Simulator 1-4244-1312-5/07,2007.

[7] Podila Swathi, Shanthi Prince,-" Designing Issues in Design of Under Water Optical Wireless Communication" Published by IEEE, ISSDN No. : 978-1-4799-3357-7 (1440-1445), 2014.