Design of Low Complexity and Interference Free Receiver For Optical Communications

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Abstract

For gigabit data transmission orthogonal frequency division multiplexing(OFDM), optical wireless communication is broadly used. In conventional optical OFDM techniques that is hybrid asymmetrically which needs extra operation for cancelling the interference to decode the data. This causes high time to transmit and occupies large area, to overcome such problem a modified hybrid asymmetric technique is used in the proposed method. In this two hybrid optical OFDM components is combined with interference free approach without degrading the performance with simultaneous transmission which is used in the broadband applications. The proposed method provides less design complexity ,area and time. This method is implemented in XILINX 12.4 ISE tool.

Keywords: OFDM, optical wireless communication, hybrid asymmetrical, Xilinx ISE.

1. Introduction

Optical wireless communication provides license free and high data rates function. In [1] coarse timing synchronization for asymmetrically clipped OFDM systems is described. This method provides less realization complexity with accurate symbol timing synchronization. In [2] iterative receiver is described for optical wireless communication. This method offers considerable signal to noise ratio gain.

In [3] MIMO OFDM Visible Light Communication that avoid the limitation of modulation bandwidth. To enhance the channel capacity and to satisfy the necessity of the transmitted signals this method utilizes the characteristics of the spatial multiplexing gain. In [4] fast acquisition of the frequency offset sample-shifted training symbols is described .In this less complexity correction approach is used.

In [5] pulse-amplitude-modulated discrete multitone and asymmetrically clipped optical OFDM signals is detected in the frequency domain and regenerated in the time domain is described. Also pair wise clipping is used to minimize the effect of error and noise. In [6] Hadamard coded modulation is described to modulate the data in direct detection. Without losing any data eliminating the signal DC bias to enhance the power efficiency of Hadamard coded modulation. In [7] encoding the information in the location of the space to enhance the data rate by using Spatial Modulation is described. This method provides less complexity.

The main objective is to minimize the time and area with less complexity, so the two hybrid optical OFDM components is combined with interference free approach with simultaneous transmission is presented. Further in this paper the sections are organized with, related work in section 2, proposed method in session 3, results and discussion in session 4 and conclusion in session 5.

2. Proposed Method

The combination of two techniques namely Asymmetrical Clipped Optical OFDM and Pulse Amplitude Modulated Discrete Multitone is utilized in the Hybrid Asymmetical optical OFDM.. On the basis of various amplitude samples of the hybrid Optical OFDM signal the time selective is initiated for providing non negativity for sustaining high power efficiency. The frequency domain for Asymmetrical Clipped Optical OFDM is expressed as

$$T=[0,V1,0\ldots,VM/4\ ,0,V^*1] \tag{1}$$

Where, M-No.of subcarriers and Vi- Quadature Amplitude Modulation

$$U=[0,0,C1,0\ldots,CM/4\ ,0,C^*1] \tag{2}$$

The Inverse Fast Fourier Transform (IFFT) of T and U provides the time domain results tn and un. Since the time-domain of Asymmetrical Optical-OFDM and PAM-DMT signals, it is represented as

$$Vn=|vn|C+|cn|c \tag{3}$$

Where n=0,1,2,…N-1.Likewise PAM-DMT signal is produces

$$Jn=tn+|un| \tag{4}$$

Figure 1 shows the Architecture for the proposed transmitter and figure 2 shows the architecture for receiver.

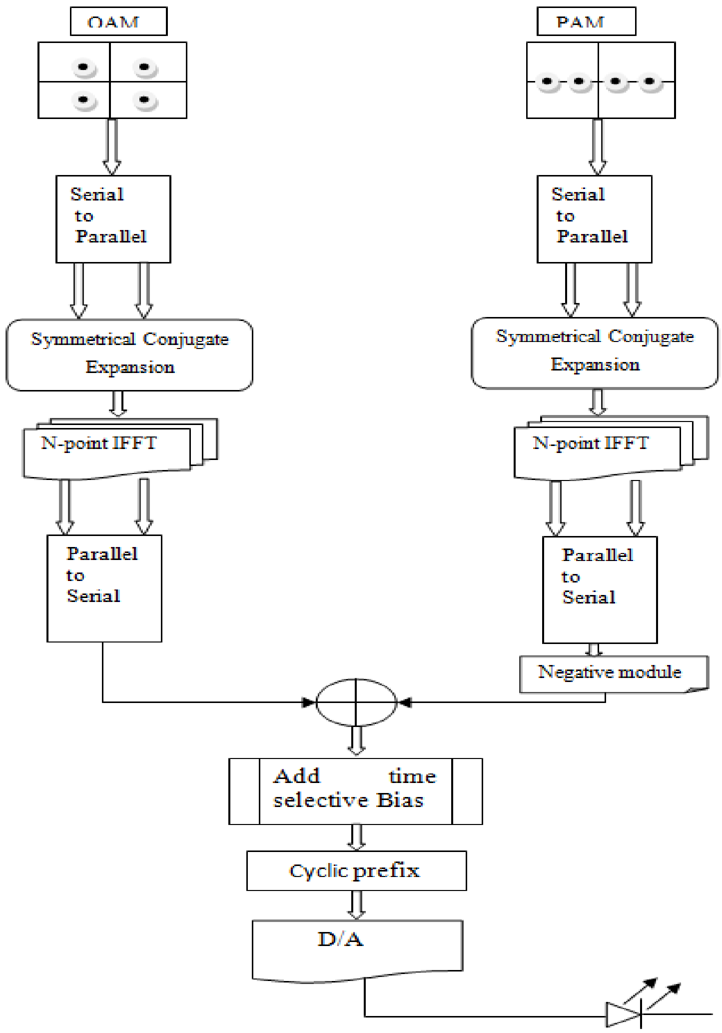

Figure. 1Proposed Architecture for the transmitter

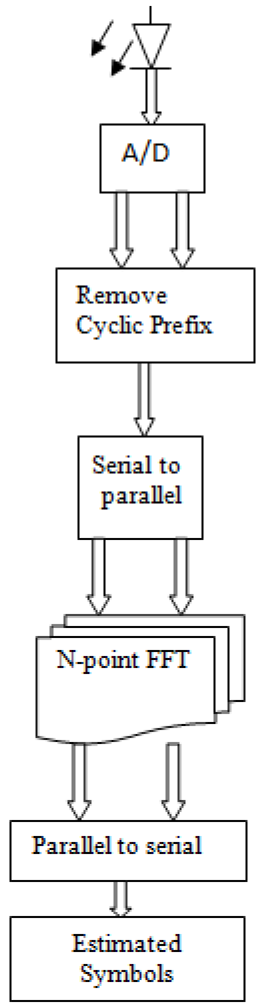

Figure. 2 Proposed architecture for the receiver

3. Results and Discussion

The proposed modified hybrid asymmetric technique for optical OFDM is implemented using Xilinx 12.4 ISE tool (Family Spartan 3,device XC3S50,package PQ208 and speed -5) and simulated using the MODELSIM 6.3c.The codes for the design is written using Verilog Hardware Description Language (HDL).Figure 3 shows the simulation waveform for the proposed optical OFDM transmitter.

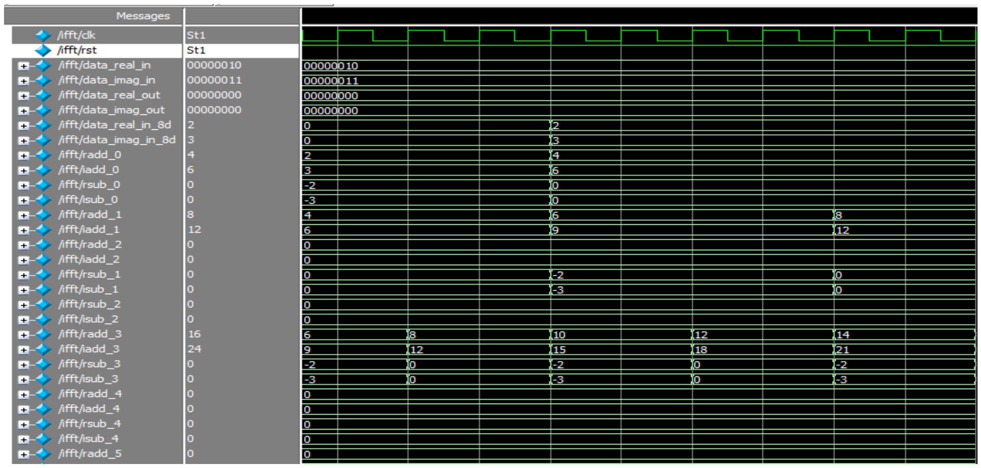

Figure. 3 Simulation for the proposed optical OFDM transmitter

Figure 4 shows the simulation waveform for the proposed optical OFDM receiver. Figure 5 shows the performance analysis of the proposed and conventional method for delay. The delay taken for the proposed method is 22.78ns and for conventional method is 18.69ns.

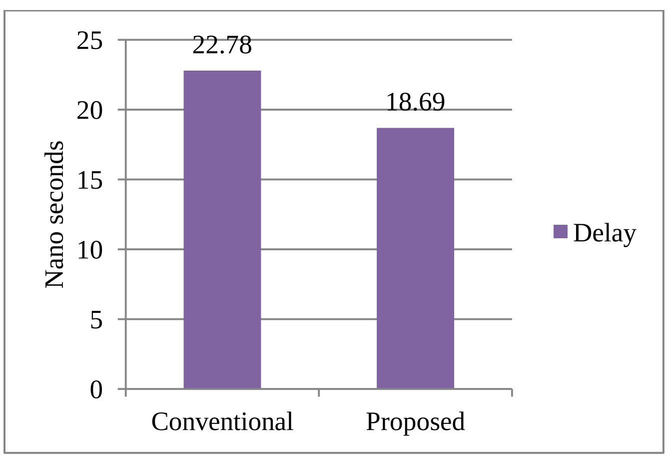

Figure. 4 Performance analysis of conventional and proposed system for Delay

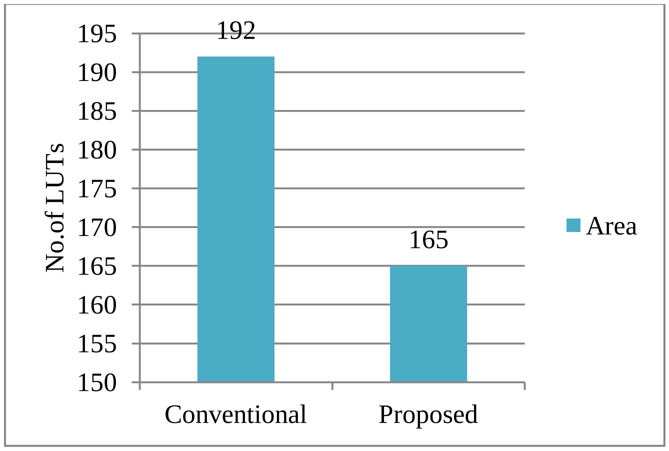

Figure.6 Performance analysis of Conventional and proposed system for Area

Figure 6shows the performance analysis of the proposed and conventional method for Area. The area occupied for the proposed method is 165 and for conventional method is 192.

4. Conclusion

In this paper modified hybrid asymmetric technique is implemented in Xilinx ISE tool is presented which is used in the optical communications. Here, two hybrid optical OFDM components is combined with interference free. The proposed method offers 17.95% reduction in delay and 14.06 % reduction in area compare to the conventional method.

References

1. Freda MM, Murray JM. Low-complexity blind timing synchronization for ACO-OFDM-based optical wireless communications. In2010 IEEE Globecom Workshops 2010 Dec 6 (pp. 1031-1036). IEEE.

2.Huang N, Wang JB, Pan C, Wang JY, Pan Y, Chen M. Iterative receiver for Flip-OFDM in optical wireless communication. IEEE Photonics Technology Letters. 2015 Jun 1;27(16):1729-32.

3.Wu L, Zhang Z, Liu H. MIMO-OFDM visible light communications system with low complexity. In2013 IEEE international conference on communications (ICC) 2013 Jun 9 (pp. 3933-3937). IEEE.

4. Fan SH, Yu J, Qian D, Chang GK. A fast and efficient frequency offset correction technique for coherent optical orthogonal frequency division multiplexing. Journal of Lightwave Technology. 2011 May 19;29(13):1997-2004.

5. Fath T, Di Renzo M, Haas H. On the performance of space shift keying for optical wireless communications. In 2010 IEEE Globecom Workshops 2010 Dec 6 (pp. 990-994). IEEE.

6.Noshad M, Brandt-Pearce M. Hadamard coded modulation: An alternative to OFDM for wireless optical communications. In2014 IEEE Global Communications Conference 2014 Dec 8 (pp. 2102-2107). IEEE.

7.Popoola WO. Merits and limitations of spatial modulation for optical wireless communications. In2013 2nd International Workshop on Optical Wireless Communications (IWOW) 2013 Oct 21 (pp. 152-156). IEEE.