

THE IMPLEMENTATION OF ITERATIVE RECEIVER BASED ON FLIP OFDM MECHANISM for ACHIEVING NON-NEGATIVE SIGNALS FOR

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Abstract

Along with growing demand for high data rate in wireless communications applications and the significant increase of the number of users, the radio frequency (RF) spectrum become one of the scarcest resources in the world. To extract nonnegative signals in optical wireless communication (OWC) systems, flipped orthogonal frequency division multiplexing (Flip-OFDM) transmits the positive and negative parts of the signal more than two back to back OFDM subframes (positive sub frame and negative subframe, individually). As the conventional receiver for Flip-OFDM transmit the data by subtracting the negative frame from the positive subframe. As the signal analysis shows that the information will be transmitted by both the subframes. But in conventional the data loss will be there. To overcome that problem in our proposed an iterative receiver is proposed to increase the performance of FLIP-OFDM by abusing the signal in two frames. Simulation results show that the proposed iterative receiver provides significant signal to noise ratio (SNR) gain over the conventional receiver.

Keywords: Flip OFDM, Iterative receiver, Optical wireless communications

1. INTRODUCTION

With the widespread organization of light-discharging diodes (LEDs), optical wireless communication (OWC) has pulled in an expanding enthusiasm for the educated community and industry recently [1]. Because of its particular focal points, for example, rich range assets and high correspondence security, OWC has been expected to be an appealing other option to radio frequency (RF) frameworks, particularly in indoor situations. Also, the joining of illumination and communication makes OWC a standout amongst the most vital green technologies [2].

A specific end goal to accomplish high information rates and mitigate inter-symbol interference (ISI), orthogonal frequency division multiplexing (OFDM) has been utilized in OWC [3]–[5]. Since intensity modulation and direct detection (IM/DD) is regularly utilized as a part of OWC frameworks, the transmitted signs must be genuine and nonnegative. Ongoing area signs can be acquired by forcing Hermitian symmetry on the OFDM subcarriers. Moreover, to manage the issue of bipolarity in OFDM signals, a few OFDM schemes have been proposed for OWC. For instance, direct current (DC) one-sided optical OFDM (DCOOFDM) [6], asymmetrically clipped optical OFDM (ACOOOFDM) [7] pulse-amplitude-modulated discrete multi tone (PAM-DMT) [8]. DCO-OFDM adds a DC predisposition to the OFDM symbols,

which expands the power dissipation of the signal significantly. ACO-OFDM and PAM-DMT needn't bother with DC bias because of the clipping operation, yet each has just a large portion of the spectral efficiency of DCO-OFDM. The creators in [9] proposed a novel OFDM procedure named as Flip-OFDM in which positive and negative parts of the sign are separately transmitted more than two sequential OFDM subframes. In [10], it was demonstrated that Flip-OFDM can be adjusted to approach the spectral efficiency of DCO-OFDM without biasing, which contributes to the practical applications of Flip-OFDM in OWC.

In the conventional receiver for Flip-OFDM, the information is recouped by subtracting the negative signal frame from the positive one [9]. This strategy is basic and clear. In any case, it expands the noise variance of the receiver symbols, aggravating the execution much than that of bipolar OFDM with the same modulation method. To enhance the execution of Flip-OFDM, a time-domain noise filtering technique was proposed in [11] and examined in [12]. In any case, the algorithm does not make full utilization of the signal structures. In this letter, an iterative beneficiary is proposed for Flip-OFDM by completely misusing the structures of the received signals. Simulations confirm that the proposed iterative beneficiary is better than different receivers.

2. RELATED CONTENT

2.1 OFDM and its Orthogonality

In orthogonal frequency division multiplexing communication model the sub carrier used are orthogonal to each other. The Orthogonality helps in

employing the overlapping between the sub carriers in the respective frequency domain. The accuracy of communication model is based on how effective the bandwidth is used and this is technically termed as spectral efficiency or bandwidth efficiency, the acquired bandwidth efficiency is free of Inter carrier interference and the absence of Inter carrier interference (ICI) is mainly because of usage of Orthogonality in orthogonal frequency division multiplexing.

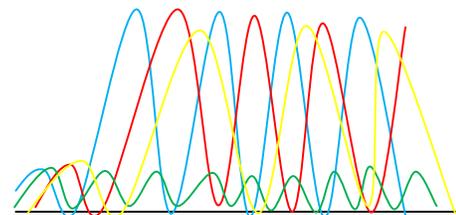
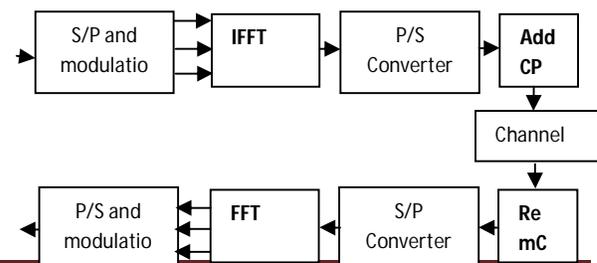


Figure 1: Orthogonality in orthogonal frequency division multiplexing (OFDM)

2.2 Basic OFDM System

The orthogonal frequency division multiplexing block diagram is illustrated as follows in figure 3. The input random signal data rate streams (high) are converted into data rate streams (low). The important aspect in the OFDM block diagram is the modulation technique which modulates the low data rate streams in parallel way and this parallel stream given input to the IFFT block which transforms the frequency data to time data before it reaches the channel. Adding the cyclic prefix acts as the guard interval and the reverse of transmission is accomplished at receiver end.



$$\hat{X}_{LOS}^{(i)} = \begin{cases} dec[y^+ - y^-], i = 0 \\ dec \left\{ \frac{1}{2} [I + W_N S(\hat{x}_{LOS}^{(i=0)}) W_N^H] y^+ \right. \\ \left. + [I + W_N S(\hat{x}_{LOS}^{(i=0)}) W_N^H - I] y^- \right\} \end{cases}$$

Figure 2: Block diagram of Basic OFDM system

3. PROPOSED METHOD

PROPOSED RECEIVER

The conventional receiver is simple and straightforward, but it does not fully exploit the structures of the received signals. In the following, a new receiver is proposed by establishing the relationship between the received signals y^+ and y^- the input data X .

Where $|x|$ can be expressed as

$$|x| = S(X)x = S(X)W_N^H X, \quad (1)$$

Where $S(X)$ is defined as

$$S(X) = \text{diag}\{\text{sign}(x)\} \text{diag}\{\text{sign}(W_N^H X)\}, \quad (2)$$

Then the positive and negative parts can be writes as follows,

$$x^+ = \frac{x+|x|}{2} = \frac{x+S(X)W_N^H X}{2}.$$

The relationship between the y^+ and X can be derived as

$$y^+ = \frac{HW_N^H S(X)W_N^H X - H}{2} X + Z^- \quad (3)$$

Particularly, in line-of-sight (LOS) channels, the channel response can be expressed as

$$h(n) = c\delta(n) \quad (4)$$

and finally the iterative receiver becomes

4. SIMULATION RESULTS

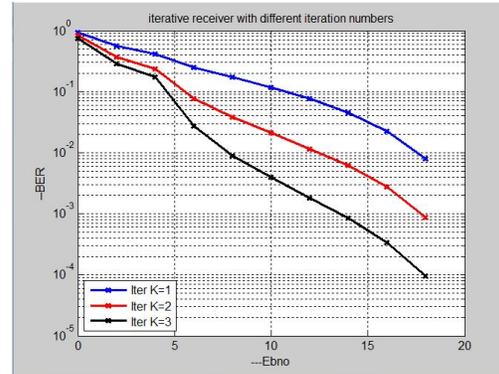


Figure 1: Iterative receiver with number of iterations

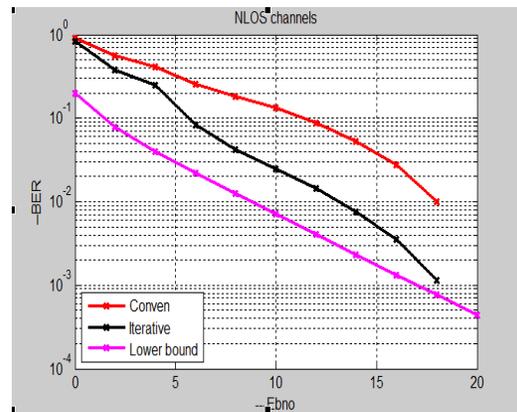


Figure 2: NLOS channel in terms of BER

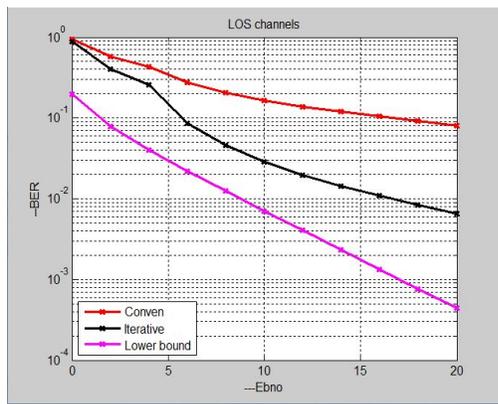


Figure 3: LOS channel in terms of BER

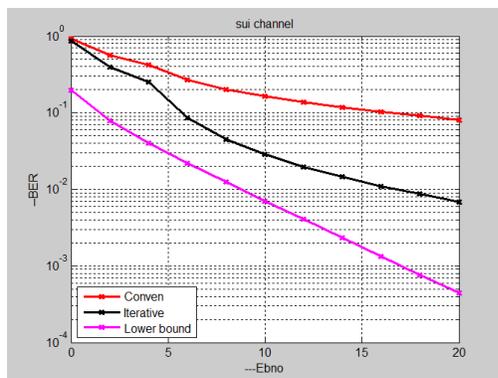


Figure 3: SUI channel in terms of BER

SNR	BER(LOS)	SUI Channel(LOS)
0	0.8945	0.8615
2	0.2225	0.2188
4	0.0988	0.0946
6	0.0550	0.0544
8	0.0352	0.0346
10	0.0231	0.0242
12	0.0174	0.0178
14	0.0129	0.0136

Compare the BER results with last 2 figures

5. CONCLUSION

An iterative receiver is proposed for Flip OFDM in IM/DD based OWC systems. In order to improve the

receiver performance, the iterative receiver obtains the additional diversity gain by exploiting the signals in both the positive sub frame and negative sub frame. In this paper, an iterative receiver is proposed for Flip OFDM in IM/DD based OWC frameworks. Keeping in mind the end goal to enhance the receiver performance, the iterative receiver acquires the additional diversity gain by exploiting the signals in both the positive subframe and negative subframe. The simulation results demonstrate that the iterative receiver provides better SNR increase over the advanced receiver. Besides, the receiver is additionally better than the existing methods. It should be noticed that the proposed iterative receiver can likewise be connected to the altered Flip-OFDM framework proposed and the multiple-input multiple-output (MIMO) framework proposed.

REFERENCES

- [1] H. L. Minh, D. O'Brien, G. Faulkner, L. Zeng, K. Lee, D. Jung, Y. Oh, and E. T. Won, "100-mb/s NRZ visible light communications using a postequalized white led," *IEEE Photonics Technology Letters*, vol. 21, no. 15, pp. 1063–1065, Aug. 2009.
- [2] J.-B. Wang, Q.-S. Hu, J. Wang, M. Chen, and J.-Y. Wang, "Tight bounds on channel capacity for dimmable visible light communications," *Journal of Lightwave Technology*, vol. 31, no. 23, pp. 3771–3779, Dec. 2013.
- [3] J. Armstrong, "OFDM for optical communications," *Journal of Lightwave Technology*, vol. 27, no. 3, pp. 189–204, Feb. 2009.
- [4] D. J. Barros, S. K. Wilson, and J. M. Kahn, "Comparison of orthogonal frequency-division



multiplexing and pulse-amplitude modulation in indoor optical wireless links,” *IEEE Transactions on Communications*, vol. 60, no. 1, pp. 153–163, Jan. 2012.

[5] N. Huang, J.-B. Wang, J. Wang, C. Pan, H. Wang, and M. Chen, “Receiver design for PAM-DMT in indoor optical wireless links,” *IEEE Photonics Technology Letters*, vol. 27, no. 2, pp. 161–164, Jan. 2015.

[6] J. Armstrong and B. Schmidt, “Comparison of asymmetrically clipped optical OFDM and DC-biased optical OFDM in AWGN,” *IEEE Communications Letters*, vol. 12, no. 5, pp. 343–345, May 2008.

[7] J. Armstrong and A. Lowery, “Power efficient optical OFDM,” *Electronics Letters*, vol. 42, no. 6, pp. 370–372, Mar. 2006.

[8] S. C. J. Lee, S. Randel, F. Breyer, and A. M. Koonen, “PAM-DMT for intensity-modulated and direct-detection optical communication systems,” *IEEE Photonics Technology Letters*, vol. 21, no. 23, pp. 1749–1751, Dec. 2009.

[9] N. Fernando, Y. Hong, and E. Viterbo, “Flip-OFDM for optical wireless communications,” in *Proc. 2011 IEEE Information Theory Workshop (ITW)*, 2011, pp. 5–9

[10] D. Tsonev and H. Haas, “Avoiding spectral efficiency loss in unipolar OFDM for optical wireless communication,” in *Proc. 2014 IEEE International Conference on Communications (ICC)*, pp. 3336–3341

[11] N. Fernando, Y. Hong, and E. Viterbo, “Flip-OFDM for unipolar communication systems,” *IEEE Transactions on Communications*, vol. 60, no. 12, pp. 3726–3733, Dec. 2012.

[12] D. Tsonev, S. Sinanovic, and H. Haas, “Novel unipolar orthogonal frequency division multiplexing (U-OFDM) for optical wireless,” in *Proc. 2012 IEEE 75th Vehicular Technology Conference (VTC Spring)*, pp. 1–5.

[13] E. G. Larsson, “MIMO detection methods: How they work,” *IEEE Signal Processing Magazine*, vol. 26, no. 3, pp. 91–95, May 2009.

[14] J. Karout, E. Agrell, K. Szczerba, and M. Karlsson, “Optimizing constellations for single-subcarrier intensity-modulated optical systems,” *IEEE Transactions on Information Theory*, vol. 58, no. 7, pp. 4645–4659, July 2012.

[15] J. R. Barry, J. M. Kahn, W. J. Krause, E. A. Lee, and D. G. Messerschmitt, “Simulation of multipath impulse response for indoor wireless optical channels,” *IEEE Journal on Selected Areas in Communications*, vol. 11, no. 3, pp. 367–379, Apr. 1993.

[16] L. Wu, Z. Zhang, and H. Liu, “MIMO-OFDM visible light communications system with low complexity,” in *Proc. 2013 IEEE International Conference on Communications (ICC)*, pp. 3933–3937.



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