Improved Least Mean Square Algorithm for 5G signals in Microwave –Photonic Link

Asish B Mathews, G.GlanDevadhas

Abstract: For the use in 5G system, common public radio interface (CPRI) is implemented for increasing the transmission capacity of conventional MFN and it exceeds hundreds of Gpbs. In this work, we proposed an improved LMS and compared it with the existing equalizers. Due to the complex nature of nonlinear effects, the nonlinearity of a signal is designed by the second order Volterra model consisting of linear and nonlinear part. By using improved LMS and Blind equalizer, the bit-error rate (BER) of the nonlinear system is diminished to a great extent. The results shows that the proposed Least mean square (LMS) and blind equalizers with constraint can decrease the inter-symbol interference (ISI) that causes nonlinearity and also helps to improve performance characteristics .

Keyword: Least mean square equalizer and blind equalizer.

I. INTRODUCTION

The expeditious enlargement of mobile head-end communications and wireless internet approach helped to produce a secure demand for inexpensive, portable, and high data rate wireless transceivers working in variety of environments. The resources like data and video power efficient transceivers should achieve reliable high speed transmissions even in high mobility scenarios. Most of these transmission systems experience degradations, such as attenuation, noise, multipath fading, interference, time variation, and non-linearity. Also it has to satisfy the constraints, such as finite transmit power and predominantly finite bandwidth requirements. In particular, multipath fading of wireless channels leads to inter-symbol interference (ISI) in single carrier systems and also limits the transmission rate. In conventional single carrier communication systems, the ISI is usually dealt with a time domain channel equalizer. The equalizer concept in single carrier communication is not feasible for high data rate communication. In high data rate transmission, the symbol duration is reduced, which makes the equalizer more complex and logically it become more complex. So it is obligatory to go for a novel technique to overcome multipath fading impairments in the most challenging wireless channel environments. Kushwah(2014) projected IEEE 802.16 as a normal standard suitable for Broadband Wireless Access (BWA) and its associated business syndicate, Worldwide Ability for Microwave Access (WiMAX) forum for supplying high rate over massive areas, wherever broadband is unobtainable.

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This paper analyzed totally differenthigher level modulations on Worldwide Ability for Microwave Access Multiple Input and Multiple Output (WiMAX-MIMO) systems with different code rates for Rayleigh channel. This abstraction diversity technique of MIMO systems combined with Wi-MAX is analyzed so as to realize higher data rates by lowering the Bit Error Rate of the system and to realize higher performance with Rayleigh channel.

  Atul Singh Kushwah (2014) made an effort to exceed the cyclic prefix (CP) and designed the constraints of the filter. X. Liu, F. Effen Berger et al., (2015) used a bandwidth - efficient mobile front haul by a novel DSP system and it is based on aggregation and de-aggregation techniques. The dispersion and non-linearity is increased and has small coverage area.

A. (Least Mean Square) LMS algorithm:

Among various equalizer systems, the LMS algorithm is very common; it is often used inpractice because of its simplicity and relative ease of implementation. The LMS filter isone of the fundamental adaptive algorithms and its performance under certain conditionsusually serves as a reference for the evaluation of other adaptive filters. The algorithmrepeatedly iterates through three successive phases: signal filtering, error calculation,and filter coefficient update.

B. Improved LMS Equalizer algorithm:

  The improved LMS equalizer input signal a(x) is given as a vector containing present sample followed by X-1 samples. The obtained output value for the Finite-Impulse Response (FIR) filter is a product between input and atransposed vector of X filter coefficients b(x).

$$y(x) = b^T(x)a(x) \qquad (1)$$

$$= \sum_{i-1}^{N} b_i(x)a(x - i + 1) \qquad (2)$$

$$e(x) = d(x) - y(x) \qquad (3)$$

$$b(x + 1) = b(x) + \mu e(x)a(x) \qquad (4)$$

Following that, the coefficients of the filter are updated to minimize the output mean squared error E. Coefficient vector a(x + 1) for the next iteration is obtained from the sum of the current coefficient vector b(n) with the weighted input vector a(x) (equation 4). The input vector is scaled with the error value e(x) and the adaptation rateμ.

C. Blind Equalizer:

In order to trace the time fluctuating behavior of the channel, training sequenceis not essential for a Blind equalizer. It finishes with a moderate convergence to ascertain a chosen signal to noise at the output. Nevertheless, the convergence rate speeds up the variable tap parameter (α) and also reduces the maladjustment of a blind equalizer. In this research, two variable approachis utilized for developing blind equalizer algorithm. By comparing the simulation results, the improved methodology is found to have better convergence rate than existing methodology.

D. Zero Forcing:

Zero Forcing Equalizer is a kind of equalizer which is employed in high data rate communication networks since it is having a linear behavior. The zero forcing equalizer applied the inverse frequency response of the medium to the received signal and after that the signal is restored. The Zero Forcing whichreduce the inter symbol interference (ISI) to a low threshold value indistortion free areas. This isbeneficial under certain circumstances where inter symbol interference is notable.

II. RESULT AND DISCUSSION

The proposed method is done in matlab2016a and the input signal is the optical signal. By using Improved LMS equalizer, BER is reduced and coverage area is improved to a large extent.
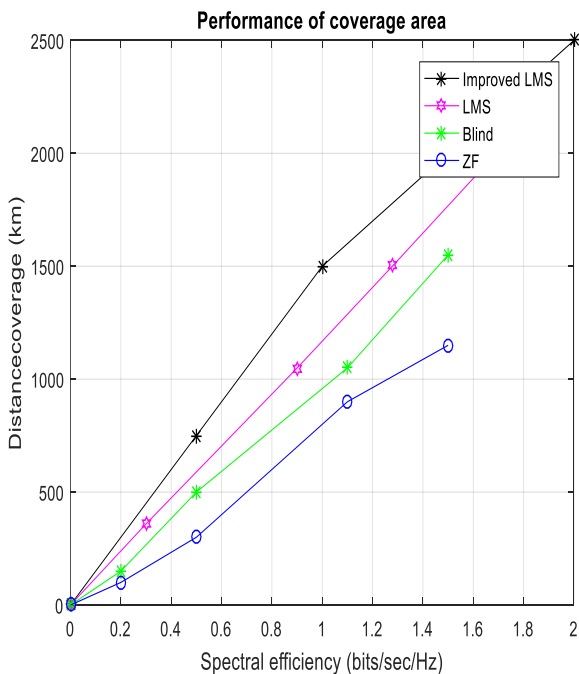

Figure 1: Performance of Coverage Area

In the above figure, it is noted that performance of coverage areais enhanced by plotting spectral efficiency against the distance coverage. In Improved LMS equalizer technique, the spectral efficiency is high without much compensation to the maximum distance covered.
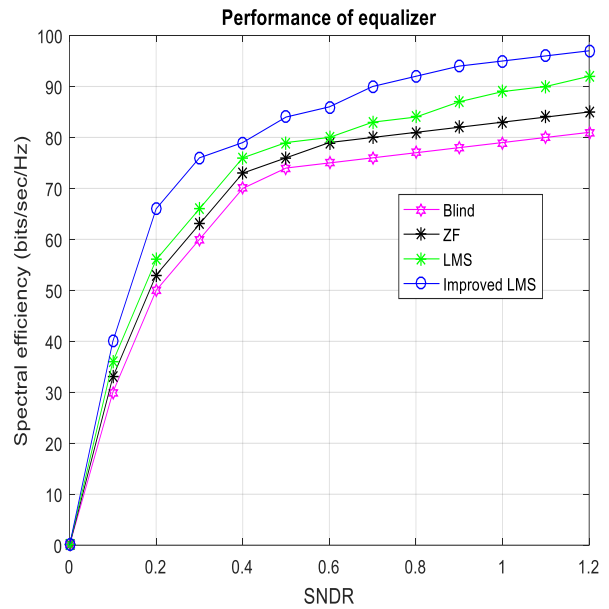

Figure 2: Performance of equalizer

In figure 2, the performance equalizer accuracy is analyzed. Improved LMS obtained the percentage of 97.85. It is proved that the proposed Improved LMS equalizer provides is a better accuracy.
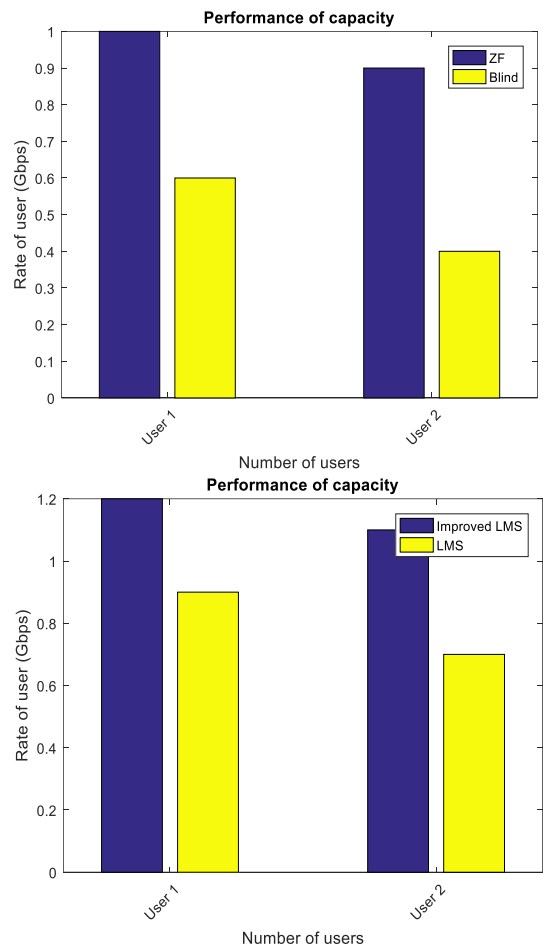

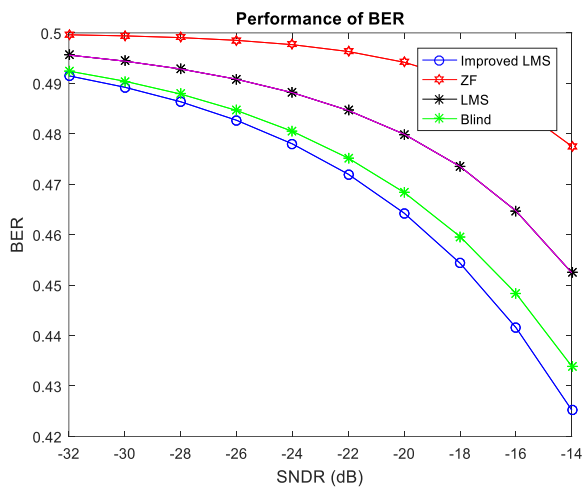**Figure 3: Capacity Performance Graph**

Figure 4: Performance of BER

Capacity performance graph is shown in the figure 3. In this figure, number of users is plotted against the rate of users. In ZF, Blind and LMS equalizer, if the total number of allowable users is increased, the data rate of users decreases accordingly. In Improved LMS, if the total number of allowable users is increased, then the data rate of users is decreased only to a certain limit which indicates a better performance in providing higher rates than existing equalizers. The above figure shows the performance of BER. Here, improved LMS equalizer SNDR value is decrease with respect to BER.

III.   CONCLUSIONS

In the proposed system, the optical signal is generated and for reducing the BER and improving the accuracy and coverage area, an improved LMS equalizer technique is employed. Experimental results show that the improved LMS equalizer is having better performance curve. The characteristics of various equalizers are plotted and compared with different techniques. BER performances are also drawn and compared. For equalizer performance, improved LMS equalizer is the best equalizer compared to ZF, Blind and LMS, it has the percentage of 97.85%.

REFERENCE

1. Kushwah, AS 2014, 'performance analysis of 2 4 MIMO-MC-CDMA in Rayleigh ading Channel Using ZF-Decoder', arXiv preprint arXiv:1402.6515.
2. Kushwah, ,'performance estimation of 2* 4 mimo-mc-cdma using convolution code in different modulation technique using zf detection scheme', arXiv preprint arXiv:1407.2207.
3. Frank Effen, B. and Xiang, L,'Power-efficient method for IM-DD optical transmission of multiple OFDM signals ', *Optics Express*, Vol.23, No.110, pp.13571-13579 (2015).
4. Yu-Kuan,C.and Fang-Biau,U. 'A Novel Turbo GFDM-IM Receiver for MIMO Communications ', *International Journal of Electronics and Communications*, pp.1-31 (2017).
5. Gerhard, F., Marco, K. and Steffen, B. 'GFDM - Generalized Frequency Division Multiplexing ', *IEEE Vehicular technology conference* (2009).
6. Chung-Yi,L., Hai-Han,L., Chun-Yu,L.,Chien-An,C., Bo-Rui,C., Hung-Hsien,L., and Chang-Jen,W,'Fiber-Wireless and Fiber-IVLLC Convergences Based on MZM-OEO-Based BLS'",*IEEE Photonics Journal* ,Vol.8,No.2 (2016).