




Analysis of BER Improvement of Adaptive Equalizer using CE and STB code

Simerjeet Kaur¹, Dr. Kamal Kumar Sharma², Mr. Navnidhi Sharma³

¹M.Tech (ECE), ²Professor, ³Assistant Professor, Dept, of ECE

E-max Group of Institutions, Ambala, Haryana, India

Article details: Received: 12 th Apr, 2019 Revision: 15 th May, 2019 Accepted: 8 th Jun, 2019 Published: 24 th Jun, 2019	Keywords: BER, multipath, unscatter, WSN, frequency response, ML algorithm, image denoising, SNR, error value, FIR, IIR filters, STB ,CE 
DOI: https://doi.org/10.17762/ijrisat25815814.19030644-50	

ABSTRACT

In a wireless communication channel, when the modulation bandwidth is exceeding the coherence bandwidth ISI takes place as the transmitted pulses are spread into the adjacent symbols. To combat the effects of ISI and noise and to reconstruct the signal and minimize Bit Error Rate (BER), the adaptive channel equalizer is used at the receiver end. Various kinds of interferences in a communication channel exist like Inter symbol Interference, Multipath Interference and Additive Interference which deals with the design of an Adaptive Equalizer. The idea of the equalizer is to build filter in the receiver that counteracts the effect of the channel. In essence, the equalizer must “unscatter” the impulse response and can be stated as the goal of designing the equalizer E so that the impulse response of the combined channel and equalizer CE has a single spike. We investigate channel equalization and introduce hierarchical and adaptive nonlinear channel equalization algorithms that are highly efficient and provide significantly enhanced bit error rate (BER) performance. Due to the high complexity of nonlinear equalizers and poor performance of linear ones, to equalize highly difficult channels, we employ piecewise linear equalizers.

1. INTRODUCTION

Adaptive equalizers are capable of correcting for ISI due to multipath in the same way as ISI from linear distortion in telephone channels. The rapidly increasing need for computer communications has been met primarily by higher speed data transmission over the widespread network of voice-bandwidth channels developed for voice communications. A modulator-demodulator (modem) is required to carry digital signals over these analog pass-band channels by translating binary data to

voice-frequency signals and back. The thrust toward common carrier digital transmission facilities has also resulted in application of modem technology to line-of-sight terrestrial radio and satellite transmission. Analog channels deliver corrupted and transformed versions of their input waveforms. Corruption of the waveform-usually statistical-may be additive and/or multiplicative, because of possible background thermal noise, impulse noise, and fades. Transformations performed by the channel are frequency translation, nonlinear or harmonic distortion, and time dispersion.

1.1 Adaptive FIR Equalization

Wireless channels vary over time and so we can't simply have a static impulse or frequency response for the equalizer. Rather the equalizer must adapt to the ever changing channel called Adaptive Equalization. This adaptation to the changing channel is achieved by training the equalizer based on the frequency response of the channel and tracking the frequency response of the channel as it varies in time. Obviously it becomes increasingly difficult to track when the channel is changing rapidly. A general form of the adaptive filter is illustrated in Figure 1.1.

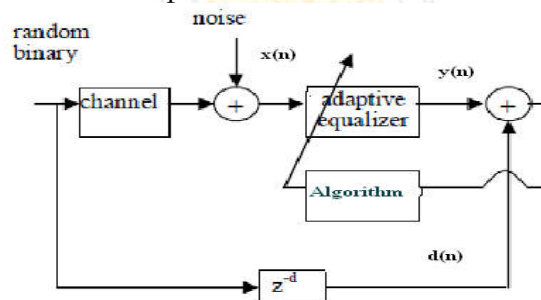


Figure 1.1 Adaptive algorithm units

A general transfer filter's architecture is illustrated in Figure 1.2. Broadband wireless systems for future mobile multimedia applications need to support high data rates in the range above tens or even hundreds of megabits per second. Radio transmission techniques for these systems have to cope with frequency selective and time-varying radio channels. In particular, a multipath propagation scenario such as broadband wireless access gives a large delay spread.

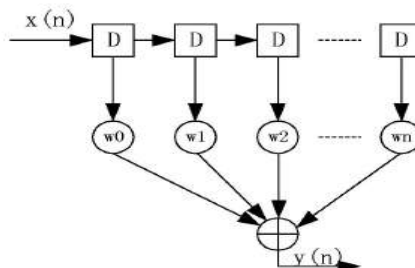


Figure 1.2 Architecture of transfer filter

$w(n) = [w_0, w_1, w_2 \dots w_n]$ is the vector of the transfer filter's coefficients having the ; $d(n)$ is the desired output of the transfer filter; $y(n)$ is the output of the transfer filter; $e(n)$ is the error value, and it can be written as:

$$E(n) = d(n) - y(n)$$

The Adaptive algorithm unit represents some algorithm to update the coefficients of the transfer filter. For LMS algorithm:

$$W(n+1) = w(n) + \mu * x(n) * e(n)$$

μ is the step of LMS algorithm. For the LMS algorithm μ is a constant. We also can have variable μ . For this comparison in this paper we choose constant μ LMS algorithm.

1.2 Space Time Block Code Technique

Equalization technique is a type of partial-response signaling that can help to reduce the required maximum frequency because it allows for a controlled amount of ISI to be removed afterward. In space time block code scheme, channel loss and Tx/Rx equalization combine to produce ISI, which may be expressed as the z function $1 + z^{-1}$ [1]. Tx/Rx equalization results in binary input data being output as a space time block signal according to the function $1 + z^{-1}$ i.e. $1 + (1) = 2$, $1 + (0) = 1$ and $0 + (1) = 1$, $0 + (0) = 0$, where the value inside each parenthesis denotes a preceding data bit. Although space time block is not Nyquist, but a partial-response signaling, we have defined the Nyquist frequency of space time block signaling to compare its characteristics with other methods. The Nyquist frequency value was determined by the sampling frequency at which you can recover original waveforms of optimum space time block single bit response with $1.5T$ symbol transition time.

2. LITERATURE REVIEW

[4]The performance evaluation of the optical access network is an important factor and is measured in terms of Bit Error Rate (BER), packet delay, packet loss probability, interference etc. Scheduling algorithm, DBA algorithm, network topology and crosstalk interference are the various issues that affects the performance of an optical network.

[6]In this paper, we have focused to adjust the maximum number of retransmission packets using a wireless network technology and developed algorithm for energy efficient and reliable WSN system.

[10]In this paper, the ML algorithm can be directly utilized to estimate the target location since the probability density function of the observation data is known with our assumption. Finally, the extensive simulation studies have demonstrated the effectiveness of our proposed algorithm.

[12]Image denoising is the basic problem in digital image processing. Removing Noise from the image is the main task to denoise the image. Salt & pepper (Impulse) noise and the additive white Gaussian noise and blurredness are the types of noise that occur during transmission and capturing. To remove these types of noise we have many filters like mean filter, median filter, inverse filter, wiener filter. No single one filter can remove both types of noise. So I design a hybrid filter which can be used to denoise these both types of noises from the image

[16]Wireless communication technology is increasing daily; with such growth sooner or later it would not be practical or simply physically possible to have a

fixed architecture for this kind of network. With the progression of computer networks extending boundaries and joining distant locations, wireless sensor networks (WSNs) emerge as the new frontier in developing opportunities to collect and process data from remote locations.

3. RESULT ANALYSIS

The objective of purposed work is to compare linear adaptive FIR equalization and space time block code scheme, for that measurement of BER at the input and also at output of the each equalization scheme.

3.1 Space Time Block Code Scheme

No. OF SAMPLES (N)	PLANT	SNR	MU	ORDER OF EQUALIZER (N)
2000	Ch	20	0.07	9

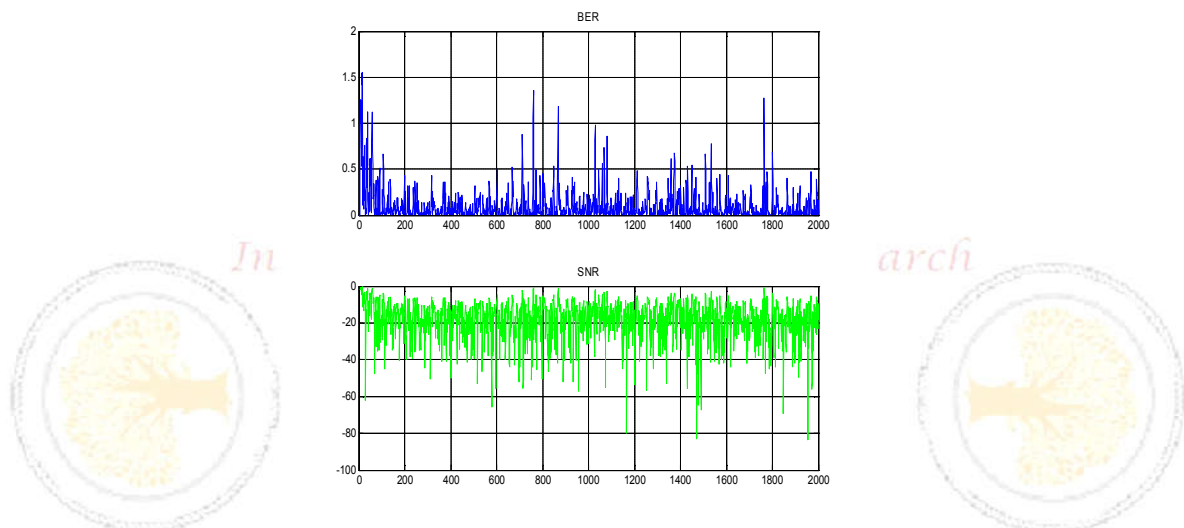


Fig. 3.1 BER and SNR

eq = -0.0168 -0.0749 0.2988 -0.7336 1.5681 -0.6889 0.3302 -0.1864
0.0684

3.2 Linear Adaptive Equalization Scheme

n = 4000; % BER , Plant = ch; SNRmin = 20; SNRmax = 100.

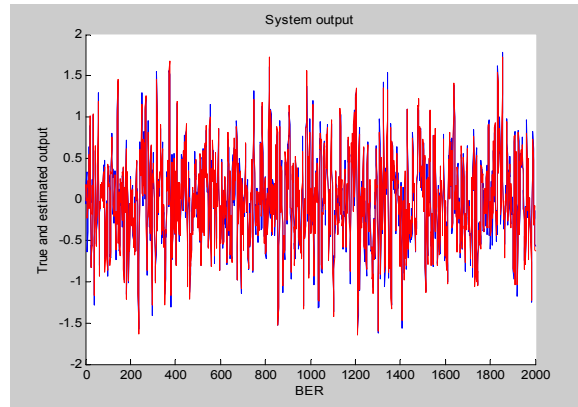


Fig. 3.2 BER vs true and estimated output

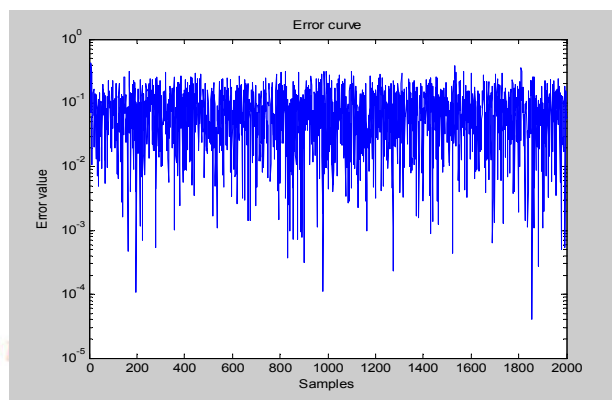


Fig. 3.3 sample vs error value

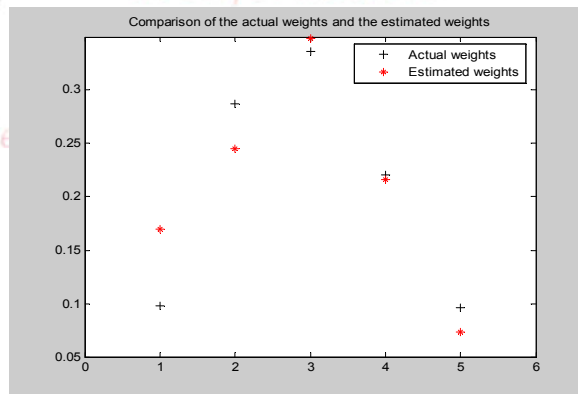


Fig. 3.4 Comparison of the actual weights
And the estimated weights Elapsed time is 299.692000 seconds.

4. CONCLUSION

They can easily be designed to be linear phase. Put simply, linear-phase filters delay the input signal, but don't distort its phase. They are simple to implement. On

most DSP microprocessors, the FIR calculation can be done by looping a single instruction. They are suited to multi-rate applications. By multi-rate, we mean either “decimation” or “interpolation” (increasing the sampling rate), or both. Whether decimating or interpolating, the use of FIR filters allows some of the calculations to be omitted, thus providing an important computational efficiency. In contrast, if IIR filters are used, each output must be individually calculated, even if it that output will discard. They have desirable numeric properties.

REFERENCES

- [1] Debendra Kumar Panda and Saima Shaikh, “BER Analysis of DFE-LMS Algorithm for Smart Antenna System”, International Journal of Engineering and Technology (IJET) 2016.
- [2] Prikshit Aggarwal and Pushparaj Pal, "Implementation of an efficient low complexity method for wireless CE using a BEM for the wireless channel taps", International Journal for Research in Applied Science & Engineering Technology (IJRASET), pp.594-600, Volume 2 Issue XII, December 2014.
- [3] Darshna Kundu and M. K. Jain, “The Comparative Study of Adaptive Channel Equalizer Based on Fixed and Variable Step-Size LMS Algorithm & its Variants for Non Stationary Wireless Channel”, International Journal of Engineering Trends and Technology (IJETT) - Volume4 Issue6- June 2016.
- [4] Vinod Kumar, Anil Kumar, and Pushparaj Pal "IMAGE DENOISING USING HYBRID FILTER", International Journal of Data & Network Security, ISSN: 2319-1236, PP.10-12, Volume 1 No.1, Aug , 2012
- [5] Seema Paliwal, Dilpreet Kaur Grover, Jyoti Krayla, Comparison of Linear and Non-Linear Equalizer using the Matlab,' Communications on Applied Electronics (CAE) – ISSN : 2394-4714 Foundation of Computer Science FCS, New York, USA Volume 4– No.1, January 2016.
- [6] Amit Kumar Kadian, Pushpraj Pal, and Vishal Goyal, "CONCEPT OF DYNAMIC BANDWIDTH ALLOCATION AND SCHEDULING ALGORITHMS IN PASSIVE OPTICAL NETWORKS", International eJournal of Mathematics and Engineering, ISSN 2249 5460 224 (2013) 2195 – 2200.
- [7] Putta Prabhu Thapaswini, Umadevi.S, Seerangasamy.V, “Design and optimization of digital FIR filter coefficients using Genetic algorithm”, International Journal of Engineering and Technical Research (IJETR) ISSN: 2321-0869, Volume-3, Issue-2, February 2016.
- [8] Amit Verma and Pushparaj Pal, "Simulation to maximize retransmission of packets in WMSN", International Journal for Research in Applied Science & Engineering Technology (IJRASET), pp.582-589, Volume 2 Issue XII, December 2014.
- [9] T. Tabassum T. and S.M.M Islam, “A Digital Video Watermarking Technique Based on Identical Frame Extraction in 3-Level DWT”,

- Proceedings of IEEE 15th International Conference on Computer and Information Technology, Chittagong, pp. 101-106, 2012
- [10] Rajnish Manwall, Aniket Mathuriya, Saruchi Garg, and Pushparaj Pal, "PERFORMANCE EVALUATION OF ENERGY SAVING IN WSN BY USING SIMULATOR NS2" *International Journal of Data & Network Security*, ISSN: 2319-1236, PP.6-9, Volume 1 No.1, Aug , 2012
- [11] Image Denoising using Wavelet Thresholding and Model Selection by Shi Zhong. *Image Processing, 2000, Proceedings, 2000 International Conference held on*, Volume: 3, 10-13 Sept. 2000 Pages: 262.
- [12] Ekta Miglani, Sachin Gupta, and Pushparaj Pal, "Simulative Investigation on 3, 4 and 5 Level Discrete Wavelet Transform for Digital Video Watermarking" *International Journal of Advanced Research in Computer Science and Software Engineering*, ISSN: 2277 128X, PP.492-500, Volume 4, Issue 6, August 2014.
- [13] M. P. McGarry, M. Maier, M. Reisslein, "Ethernet PONs: A Survey of Dynamic Bandwidth Allocation (DBA) Algorithms," *IEEE Optical Communications*, Vol. 42, No. 8, pp. S8- S15, 2004.
- [14] Yashbir, Ashish, and Pushparaj Pal "An OFDM system to reduce PAPR on different values for QAM- An Implementation" *Innovative Research in Applied Science and Technology*, PP.42-49.
- [15] Damayanti Datta and Sukhamay Kundu, "An Application-Specific Reliable Data Transfer Protocol in Wireless Sensor Networks", *Journal of Networks*, 2008.



in Informative



Science Application & Techniques

