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Multi Modulus Blind Equalizations for Quadrature Amplitude Modulation

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ABSTRACT*:* Future services needed the high data rate and reduced Bit Error Rate. The Multi Modulus Blind Equalization scheme for the Quadrature Amplitude Modulation was proposed in this paper. The algorithm includes the Cascaded Multi Modulus Blind Equalization. The constant modulus algorithm was used for the equalization of the demodulated signal. In the constant modulus algorithm the Bit Error Rate is in moderate range and convergence rate is low. Proposed MMA is the modified CMA based on the cost function. The CMA needs the separate Phase recovery system. The Proposed Algorithm does not need the separate system for phase recovery. The system was demonstrated with simulation and results are compared with CMA which provides high data rate and reduced BER.

KEYWORDS: Blind Equalization, Cost function, CMA, MMA

I. INTRODUCTION

In the Wireless Communication the most important problem is data loss due to the Inter Symbol Interference. During the long distance communication or the moderate distance communication wireless medium in the receiver section the noise will be added [1]. In the communication the demodulation only takes 80% of the work Due to the Multi Path Propagation the ISI was introduced in the signal.

The equalization process was uses to remove the ISI. The equalization is the process of adjusting the frequency components of the channel. Inter Symbol Interference is defined as the signal bandwidth is greater than the channel bandwidth. So by adjusting the frequency components of the channel which adjustment with the signal where the ISI is reduced. There is the number of the equalizations are available for the equalization process for example Decision Feedback Equalizer, Least Mean Square and Constant Modulus Algorithm etc., The CMA only mostly used algorithm for the channel equalization. The constant modulus algorithm uses the constant modularity of the signal. It is used depending on the simplicity of modulation and reduces complexity while using in the demodulation [2].

CMA have the assumptions that input to the channel is a modulated signal which has constant amplitude at every instant in time. The advantage of the blind equalization is the bandwidth is high because of there is no training of the pulses. In the conventional equalization process needs the training of the pulse. CM used for QAM signals where the amplitude of the modulated signal is not the same at every instant. The error *e(n)* is then determined by considering the nearest valid amplitude level of the modulated signal as the desired value[1]. The conventional communication system was given in figure1.

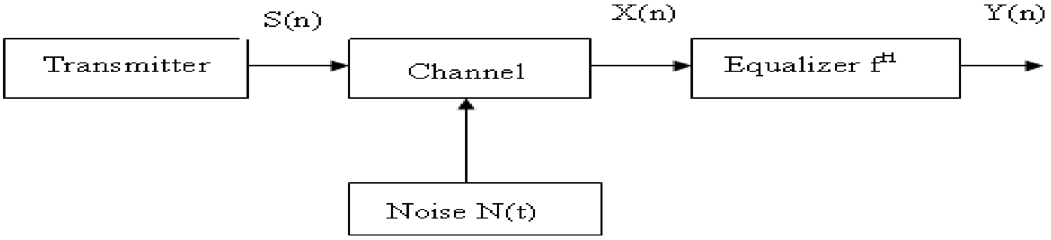

Figure 1 Communication System with equalizer

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Blind Channel Equalizations and Types

The blind equalization is the emerging method of the equalization because of the simplicity. Blind channel equalization is also known as a self-recovering equalization [4]. The objective of blind equalization is to recover the unknown input sequence to the unknown channel based solely on the probabilistic and statistical properties of the input sequence. The receiver can synchronize to the received signal and to adjust the equalizer without the training sequence [5]-[6]. The term blind is used in this equalizer because it performs the equalization on the data without a reference signal. Instead, the blind equalizer relies on knowledge of the signal structure and its statistic to perform the equalization.

1. Blind signal is the unknown signal which would be identified in output signal with accommodated noise signal at receiver.
2. Channel equalization uses the idea & knowledge of training sequences for channel estimation where as Blind channel equalization doesn't utilizes the characteristics of training sequences for frequency and impulse response analysis of channel.
3. Blind Channel Equalization differs from channel equalization and without knowing the channel characteristics like transfer function & SNR it efficiently estimate the channel and reduces the ISI by blind signal separation at receiver side by suppressing noise in the received signal.

II. RELATED WORK

In [7] authors used the Multi modulus Algorithm with blind equalization for the Quadrature Duo Binary Spectrum Shaped QPSK signals. In that the Cascaded Multi Modulus Algorithm was used along with the QPSK partitioning which gives the better frequency response and the valuable BER value. The system which uses the QPSK for the modulation it has high error the QPSK is able to tolerate the error and gives the better performance than the other modulation schemes. In [8] blind equalization and the importance of the blind equalizations are taken into the account. Because the use of blind equalization reduces the use of bandwidth. In the blind equalization there is no need of the pilot signal as the reference. Depending on the cost function the constant modulus and multi modulus algorithms are use for the equalization. In [9] the brief explanation about the cost function of the equalizer and the value of the cost function exceeds the threshold value the equalization algorithm switch to the constant modulus algorithm to the multi modulus algorithm. In the multi modulus algorithm there is no need of the phase recovery system. In [10] the use of the constant modulus algorithm for blind equalization it only deals with the real part of the signal. So need of the separate phase recovery system for recovering the signal blindly. But the Multi Modulus algorithm deals with both the real and imaginary part. In [11] the sliced multi modulus algorithm which modifies the step size and the performance of the system will improve. Its mainly concentrate the Bit Error Rate of the Communication because by controlling the BEr only the Data Rate of the system will improve.

III. PROPOSED ALGORITHM

A. *Constant Modulus Algorithm*

Adaptive channel equalization without a training sequence is known as blind equalization. A baseband model with a channel impulse response, channel input, additive white Gaussian noise (AWGN), and equalizer input are denoted by c(n),s(n), w(n), and ,u(n) respectively. The data symbols transmitted s(n} , are assumed to consist of stationary independently and identically distributed (i.i.d.), real or complex non-Gaussian random variables.

The equalizer input,

$$u(n)=s(n)*c(n)+w(n) \quad (1)$$

is then sent to a tap-delay-line blind equalizer with impulse response , intended to equalize the distortion caused by intersymbol interference (ISI) without a training signal.

The output of the blind equalizer

$$\begin{aligned} y(n) &= u(n)*f(n) \\ &= s(n)*h(n)+w(n)*f(n) \\ &= \sum_i h(i)s(n-i)+\sum_i f(i)w(n-i) \end{aligned} \quad (2)$$

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it can be used to recover the data transmitted symbol s(n),

where h(n)=c(n)*f(n)

B. *Cost Function Of CMA*

The cost function of the constant modulus algorithm was

$$J_{CMA}(n)=E\{[\,|y(n)|^2 - R_2\,]^2\} \quad (3)$$

where

$$R_2 = E\{|s(n)|^4\} / E\{|s(n)|^2\}$$

Depending on the cost function only the blind equalization was determined.

C. *Multi Modulus Algorithm*

The tap weight vectors are the co efficient of the equalizers which is by determining the transfer function of the equalizer. The tap weights are frequently updated to minimize error at the output of the equalizer. It is used to measure of the deviation in the output which provide difference between the actual value.

There are two ways of acquiring new tap weights for the equalizer. One is to transmit a training sequence known by both transmitter and receiver at the beginning of the communication. The receiver then detects the impulse response of the channel from the training sequence, and obtains the tap weights by computing the inverse transfer function of the channel. The other way is to predetermine an initial value for each of the tap weights, and design a cost function according to the characteristics of the received signal. The tap weights are continually adjusted by reducing the cost of the cost function until the error is minimized.

The cost function of Multi Modulus Algorithm was

$$J_{MMA} = J_R(n)+J_I(n)$$

$$= E\{[\,|y_R(n)|^2 - R_{2,R}\,]^2\} + E\{[\,|y_I(n)|^2 - R_{2,I}\,]^2\} \quad (4)$$

where

$$R_{2,R} = E\{|s_R(n)|^4\} / E\{|s_R(n)|^2\} \text{ and } R_{2,I} = E\{|s_I(n)|^4\} / E\{|s_I(n)|^2\}$$

It allows the both blind equalization and carrier phase recovery .

Decomposing the cost function of MMA into the real and imaginary parts thus allows both the modulus and the phase of the equalizer output to be considered; therefore, joint blind equalization and carrier-phase recovery may be simultaneously accomplished, eliminating the need for a rotator to perform separate constellation-phase recovery in steady-state operation. The tap-weight vector of the MMA is updated according to

$$f(n+1)=f(n)-\mu.e^*(n)u(n)$$

Where

$$e(n)= e_R(n)+je_I(n)$$

$$e_R(n)= y_R(n)\,(y_R(n)^2 - R_{2,R})$$

$$e_I(n)= y_I(n)\,(y_I(n)^2 - R_{2,I})$$

The results of the analysis indicate that the MMA alone can remove ISI and simultaneously correct the phase error, because it implicitly incorporates a phase- racking loop, which automatically recovers the carrier phase.

D. *Variable step size equalization*

The variable step size with the parameter which gives smaller then the MMA

$$0<\mu<2/r$$

Here the r is the greatest Eigen value in the matrix R.

It gives the improved performance when compared to the multi modulus algorithm.

IV. Simulation Results

The simulation based on the MATLAB and the transmitted symbols are represented in the graph. The second graph involves the symbols which are transmitted over the AWGN channel. When comparing the transmitted and the received symbol which has the more error. And then the next graph the symbol which is after the equalization of the signal. The next graph which plotted between the error signal and the convergence rate. And next graph is the simulation of proposed system when comparing two graph the proposed system has the improved performance.

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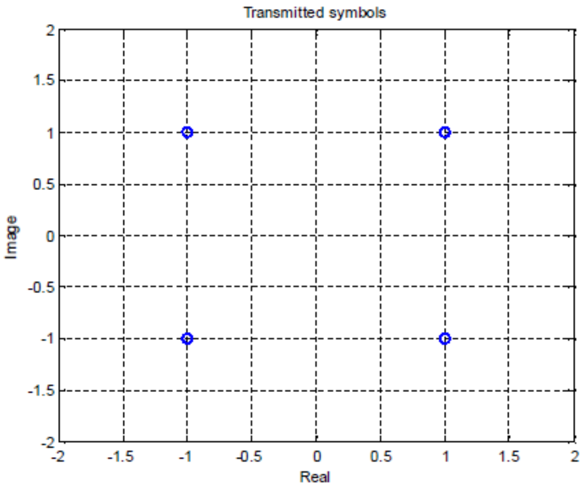

Fig.2. transmitted symbols

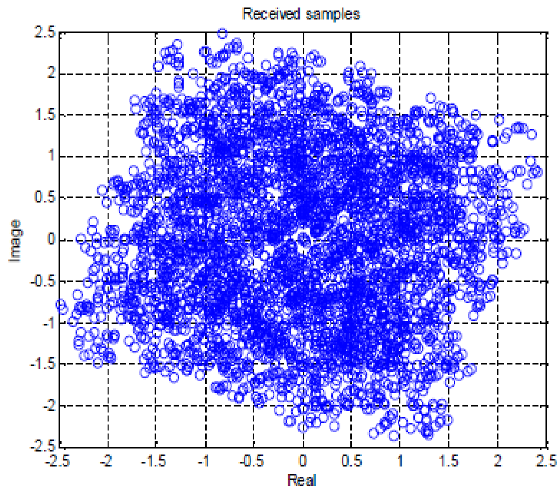

Fig. 3. Received symbols

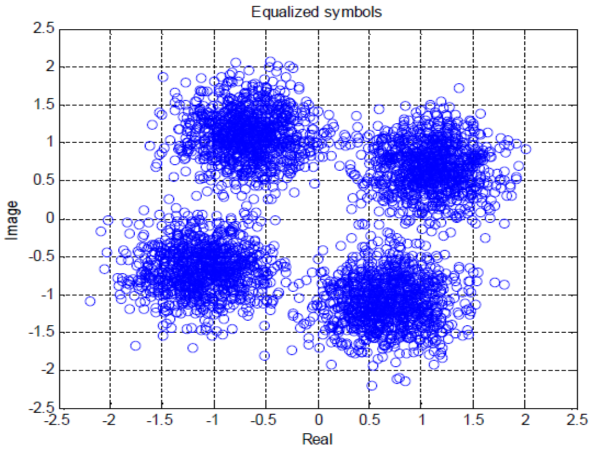

Fig. 4 After the Equalization

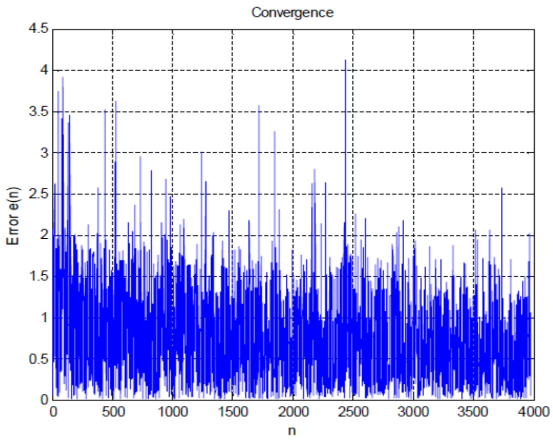

Fig 5. Covergence by CMA

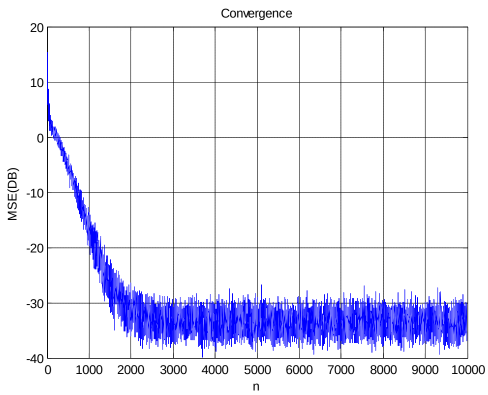

Fig 6 MMA convergence with error

V. CONCLUSION AND FUTURE WORK

The novel digital signal processing of multi modulus blind equalization of the QAM signal which applying of the cascaded multi modulus algorithm does not need has the separate phase recovery system. The cost function gives tap weight vector which gives the coefficients of the equalizer. The equalizer change the frequency components of the

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channel and the ISI was minimized was demonstrated experimentally. The mean square error and the bit error rate are reduced when comparing simulation results of the system. In future it is needed for the robust algorithms with reduction in the complexity and increase the data rate of the communication system.

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BIOGRAPHY

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