PERFORMANCE OF INTERLEAVER IN RS CODES WITH QAM SCHEME IN AWGN CHANNEL FOR MIMO SYSTEMS

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ABSTRACT: *Multiple-input multiple-output (MIMO) is a promising technology for next generation wireless systems to enhance capacity and robustness of the link. MIMO technology is enabled by the presence of multiple transmit antennas and multiple receive antennas in the communication link and is being investigated for cellular communication.*
Forward Error correction techniques are used for error correction. In this paper we have used Reed- Solomon Codes using inter-leaver for error correction and detection .In these types of codes redundant information is added at the end of message to detect and correct error. R-S Codes are used to recover original codeword from corrupted received word and inter-leaver helps in spreading the error. In this paper we develop a Simulation program using MATLAB for Reed -Solomon Codes using inter-leaver and QAM modulation scheme using AWGN. The performance comparison is made on the basis of bit error rate (BER) and symbol error rate (SER) and Signal to Noise Ratio (SNR).

Keywords—– Inter-leaver, Reed solomon codes, mimo, QAM technique, AWGN, BER, SER, SNR

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1. INTRODUCTION

In communication systems, the main purpose is to transmit a message and receive it with no error. If there is an error during transmission, the need of retransmission of message over noisy channel is required. To tackle this problem Forward Error Correction (FEC) is introduced, known as Reed-Solomon codes. In these types of codes we systematically add redundancy at the end of the message so as to enable the correct retrieval of message despite errors in the received sequences. This eliminates the requirement of retransmitting the message.

Reed-Solomon codes are the most commonly used in all forms of transmission and data storage for forward Error correction (FEC). Many algorithm for this code have been constructed and each of them have their own properties such as correcting errors beyond their error correcting capability, low complexity, lower probability of error.

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2. RS- ENCODING

Consider the finite field with q elements, GF (2m). The message to be transmitted, f, consists of k elements of GF (2m) [2].

f =(fo, f1, …..f k-1) , fi € GF(2m) (5)

The message symbol can be considered to be the coefficients of a degree k - 1 message polynomial which to be encoded,

$$f(x) = f_0 + f_1 x + f_2 x^2 + \ldots + f_{k-1} x^{k-1} \quad (6)$$

While the coefficients of the remainder is 2t parity-check digits, where

$$b(x) = b_0 + b_1 x + \ldots + b_{2t-1} x^{2t-1} \quad (7)$$

Hence, the output codeword to be transmitted is

$$v(x) = f(x) + b(x)$$
$$= v_0 + v_1 x + v_2 x^2 + \ldots + v_{n-1} x^{n-1} \quad (8)$$

3. RS -DECODING

During transmission, any codeword received at the receiver is assumed to be corrupted by the noise in the channel that introduces errors in the communication system [2]. Let say if the received corrupted-codeword is assume to be r(x), hence we have

r(x) = c(x) + e(x) (9)

where c(x) is the original codeword and e(x) is the error pattern polynomial and can be described as

$$e(x) = e_{n-1}x^{n-1} + \ldots + e_1 x + e_0 \qquad (10)$$

Each of the coefficients e n-1…e0 is an m-bit error value, represented by an element GF(2m), with the errors position in the code-word being determined by the degree of x for that term.

if more than t = (n-k)/2 of the e values are nonzero, then the correction capability of the code is exceeded and the errors are not correctable. However, Reed-Solomon algorithm still allow one to detect if there are more than t errors and for this cases, the codeword is declared un- correctable.

4. INTER-LEAVER

An interleaving is usually added between two codes to spread burst errors across a wider range. An Inter-leaver improves the error rate in communication system whose channel produces a burst error. This method is implemented in such a manner that an inter-carrier Inter-leaver rearranges carrier numbers according to an error correction method, Interleaving and De Interleaving is useful for reducing errors caused by burst errors in communication sys-tem. Figure 2 shows the basic interleaving process.

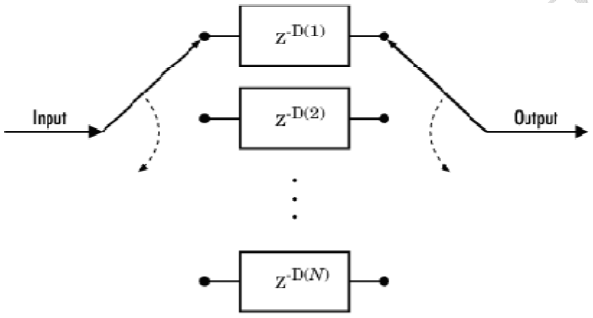

Fig. 1 - The basic Interleaving process

5. PROPOSED METHODOLOGY

If there are *k*-information symbols as the input message which set to be random, the channel encoder will map each of the information sequence into a unique *n*-symbols sequence, known as *code word.* The amount of redundancy bit in this manner is depends on the requirement of the system. It is also measured by the ratio, *n/k*. Meanwhile, the code rate for a system is *k/n*. This codeword will then be passed to the digital modulator and for this project; the modulation scheme used is QAM. The primary purpose of digital modulation is to map each of the information sequence into signal waveforms. In addition, AWGN channel will be the physical medium used to transmit and receive the signal. For every transmission through a channel, there exist corruptions in a random manner on the transmitted signal by a variety of possible cause such as man-made noise, atmospheric noise and etc. At the receiver, the digital demodulator processes the channel-corrupted signal waveforms and reduces it into a sequence of data symbols. As a final step, the channel decoder will decode and attempts to reconstruct the received output sequence to get back the original information data. However, the capability of correcting errors are depends on the system.

The inter-leaver is to be used between RS encoder and modulator and at the receiver the De-inter leaver is made available to recollect all the information.

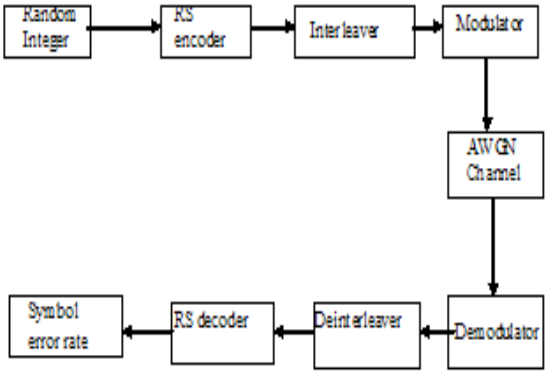

Fig.2 Block diagram of the system

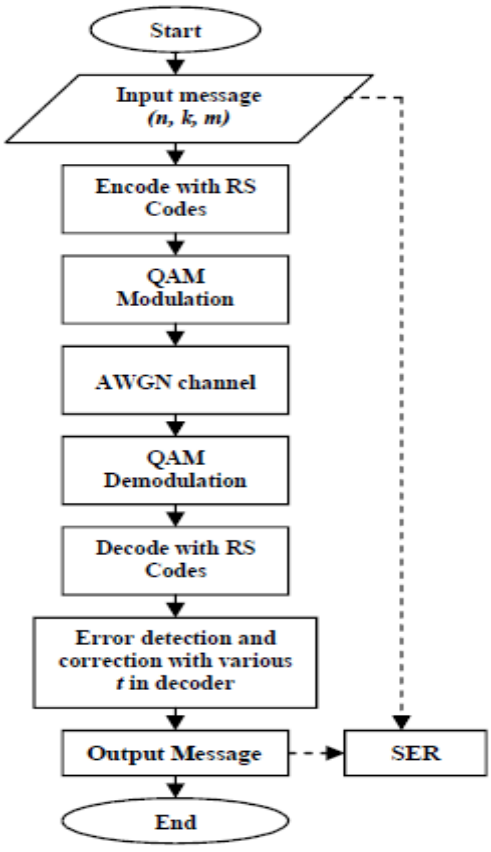

Fig.3 Flow chart of Simulation process

6. RESULT

The following figure shows the BER performance through AWGN channel, Rayleigh and Rician fading channels using Quadrature Amplitude Modulation (QAM) technique. The effect of AWGN channel and fading (Rayleigh & Rician) channels is shown.

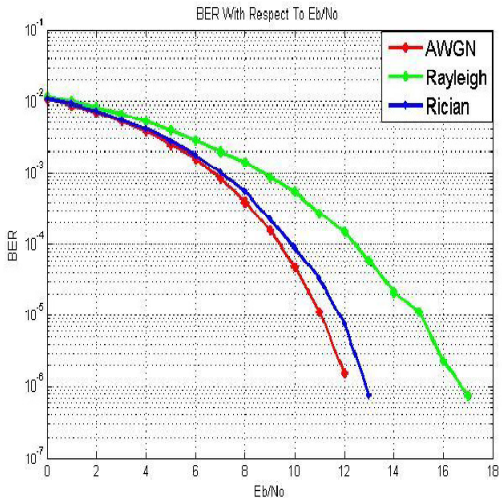

Fig.4-Performance of BER using QAM modulation technique

Figure 7 show the system performances of R-S (7, 3). From the figure, the red line represents the simulated result while the blue line represents the theoretical result. The simulation results can easily distinguish from the theoretical results. Careful observation shows that the simulation results are closer to the theoretical results of SER at higher EbNo.

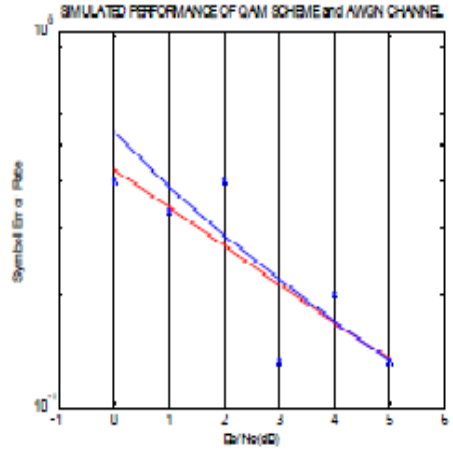

Fig.5 BER for R-S (7,3) code with Inter Leavers

The performance analysis shows the following results.

1. The Bit Error rate is least for inter-leaved RS coded QAM in AWGN channel for MIMO system.

2. The SER is least in case of inter-leaved RS coded QAM in AWGN for MIMO system.

TABLE 5.1

PERFORMANCE COMPARISON OF BER FOR RS CODES AND RS CODE WITH INTER LEAVER

Eb/No	0	1	3	5
BER FOR RS CODES	0.7521	0.5988	0.2667	0.1256
BER FOR INTER LEAVER	0.6257	0.5623	0.2573	0.1255

7. CONCLUSION

From the above experiment & result analysis it is very clear that the reed Solomon codes makes an magnificent effect on the Bit error Rate and Signal to Noise Ratio while it is used with Inter leavers.

The Inter Leavers as shown in Table 5.1 reduces the Bit error rate as compared to RS codes without inter leaver.

8. REFRENCES

[1]Feng Zhao, Aun Ali Tahir(January 2009) Performance analysis on Modulation Techniques of W-CDMA on Multipath fading channel.

[2]Abhijyoti Ghosh,(July 2012)"Comparative study of bit error rate (ber) for mpsk-ofdm in multipath fading channel" International Journal of Advances in Engineering & Technology, ISSN: 2231-1963

[3]M. A. Masud, M. Samsuzzaman, M. A.Rahman(March 2010) "Bit Error Rate Performance Analysis on Modulation Techniques of Wideband Code Division Multiple Access" journal of telecommunications,volume 1, issue 2, march 2010

[4] Tushar Kanti Roy (July 2012) "Comparative BER Performance Analysis of OFDM System using BPSK Modulation Technique over AWGN and Rayleigh Fading Channel",Volume – 1, Issue – 3 ,Article #02, IJAR-CSIT,ISSN: 1839-8480.

[5]Nuzhat Tasneem Awon, Md. Mizanur Rahman" Effect of AWGN & Fading (Raleigh & Rician)channels on BER performance of a WiMAX communication System" (IJCSIS) International Journal of Computer Science and Information Security,Vol. 10, No. 8, August 2012

[6]Suchita Varade, Kishore Kulat," BER Comparison of Rayleigh Fading, Rician Fading and AWGN Channel using Chaotic Communication based MIMO-OFDM System" International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-1, Issue-6, January 2012

[7] Khalid ibrahim alkhudairi,"diversity analyses for m-qam in rician fading channels. king saud university,may 2005

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