Error analysis of Data throughput and BER For the Wireless OFDM PSK Network

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ABSTRACT

Wireless Communication is one of the greatest contributions to mankind. The main goal of wireless communication is to provide communication with high data rates. During this transmission over a wireless link, the sidebands from various carriers might overlap and give rise to interference. OFDM combats these interferences. OFDM is a multicarrier technique in which high data single stream are transmitted over a number of minimum data rate parallel sub-carriers. Due to this, the symbol duration tends to increase and reduce the effects of multipath spread delay. Also for spectral efficiency, the cognitive radio is designed to utilize the best channels in periphery. It automatically detects the ready to be drawn channels in a wireless spectrum and then transmutes the reception and transmission parameters accordingly. In this paper, The error analysis is presented in OFDM system error correction with PSK modulation by using forward codes (RS and BCH) in order to get low BER, high data rate and also resilience the interferences in AWGN, Rician, Rayleigh channels and the result is stimulated using LABVIEW.


INTRODUCTION

Wireless communication has become vital which uses free space as a communication channel. Now a days we mostly use digital signals, DSP and communication is also in digital, because it has immunity (protection) to noise and external interference. The main objective of transmitting digital information is to minimize errors. It can be done by implementing error correction and detection techniques in digital communication systems. These techniques enable addition of extra bits to the transmitted message. The extra bits convey no information by themselves but it has the ability to detect or correct errors in the regenerated message. There are two types of error messages:

1. Lost message which never arrives at the destination.
2. Damaged message which recognized at the destination but contains one or more transmission errors.

There are two transmission handling errors

- Error detecting codes
- Error correcting codes.

Error detecting codes has enough redundant information with each transmitted message to enable the receiver for determining the error occurred. Parity bits, frame and block check characters and cyclic redundancy characters are examples for error detecting codes. Error correcting codes include sufficient extraneous information along with each message enabling the receiver to determine when an error has occurred and which of the bit is in error.

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Forward error correction technique:

FEC is the error correction scheme that detects and corrects the transmission errors when they are received, without the need of retransmission. With FEC, redundant bits are added to the message before transmission when the error is detected, the redundant bits are used to determine which bit is in error, and the simple method of complementing is correcting the bit. The number of redundant bits necessary to correct errors is much greater than the number of bits needed to simply detect errors.

FEC is generally limited to one, two, three bits.

- There is several error controlling codes that are available.
- RS (Reed-Solomon) and BCH (Bose-Chaudhari-Hocquenghem) are the most important codes used to detect and correct multiple symbol error.

Ofdm system:

Orthogonal frequency division multiplexing (OFDM) schemes are utilized as a digital multicarrier modulation technique. In most of the parallel data streams or channels to carry the data an immensely colossal number of proximately spaced orthogonal sub-carrier signals will be used. Each of the sub carriers are modulated based on the conventional modulation schemes. Each subcarrier is orthogonal to other subcarriers; where OFDM is differentiated from the commonly used FDM. OFDM helps to simultaneously transmit multiple signals in a single transmission path. The signal is modulated by data it travels with its own unique frequency range. In the OFDM spread spectrum method the data is distributed over a broad number of carriers which are spaced flat of accurate frequency. The orthogonality is achieved by this spacing where it will prevent the demodulators by viewing frequencies other than to their own. OFDM transceiver is shown in Figure 1.

![OFDM transceiver](image)

I. Bose-Chaudhri-Hocquenghem Codes:

In wireless applications, these are among the most potent cyclic block codes which are widely utilized. BCH codes are used to correct multiple random errors. From the specification of the error-correcting capability the code can be designed. Hamming code is a special type of BCH Code whose error correcting ability is 1. For any type of positive pairs of integer v and t; there will be binary(n,k) BCH code with given parameters. This code can rectify all coalescences of t or few errors.

II. Reed-Solomon Codes:

They are a widely used subclass of non-binary BCH codes. The RS codes are well apposite for burst error rectification. In addition to that; efficient coding methods are easily available for the RS-codes. If both type of error are common a technique called interleaving is employed. It is capable of detecting and correcting multiple symbol errors. They are most well suited as multiple-burst-bit-error correcting codes.
Fig. 2: BCH Lab VIEW Coding

Fig. 3: RS Lab VIEW Coding

Table I: BCH and RS Parameters

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>BOSE-CHAUDHRI-HOCQUENGHEM</th>
<th>REED SOLOMON</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLOCK LENGTHS</td>
<td>n = 2^v-1</td>
<td>N=2^v-1</td>
</tr>
<tr>
<td>NO OF CHECK BITS</td>
<td>N - k &lt;= v</td>
<td>n-k = v(2t)</td>
</tr>
<tr>
<td>MIN DISTANCE</td>
<td>Dmin&gt;=2t+1</td>
<td>Dmin=2t+1</td>
</tr>
</tbody>
</table>

III. AWGN Channel:

AWGN channel will integrate the white Gaussian noise to signals that pass through it. Additive white Gaussian noise (AWGN) channels are circumscribed with the noise on high data rate communication.

The signal received with the interval 0≤t≤ T can be expressed by, where, n(t) indicates the sample function of AWGN process with spectral power density.

\[ r(t) = S(t) + n(t) \]

IV. Comparison Of Rs And Bch With Awgn Channel:
Fig. 4: Comparison of RS and BCH with AWGN Channel

![Diagram of RS and BCH comparison with AWGN Channel](image1.png)

Fig. 5: BCH versus RS comparison over AWGN channel

![Graph showing BER vs Eb/N0 for BCH and RS](image2.png)

Table 2: Comparison of coding

<table>
<thead>
<tr>
<th>Eb/N0</th>
<th>WITHOUT ENCODING</th>
<th>BCH CODING</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.0039703</td>
<td>0.0023754</td>
</tr>
<tr>
<td>7</td>
<td>0.007551170</td>
<td>0.0015202</td>
</tr>
<tr>
<td>8</td>
<td>0.0003050412</td>
<td>0.0001450225</td>
</tr>
<tr>
<td>9</td>
<td>0.0000500068</td>
<td>0.0000250039</td>
</tr>
<tr>
<td>10</td>
<td>0.0000150020</td>
<td>0.00000500089</td>
</tr>
</tbody>
</table>

Table 2: BER System performance in AWGN channel

<table>
<thead>
<tr>
<th>SNR</th>
<th>BER</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>0.068</td>
</tr>
<tr>
<td>6</td>
<td>0.088</td>
</tr>
<tr>
<td>10</td>
<td>0.101</td>
</tr>
<tr>
<td>15</td>
<td>0.08075</td>
</tr>
<tr>
<td>20</td>
<td>0.087</td>
</tr>
</tbody>
</table>

Conclusion:

Wireless communication has become vital which uses free space as a communication channel, the cognitive radio is a technology which proved that it is best in the developing wireless systems. The graphical results obtained shows that BCH codes is the best code than Recodes. The future works includes the OFDM implementation using three transmitters and three receivers using available bandwidth. Cognitive radio technique is to sense the spectra and to mobilize it. Withal the consideration for hardware entelechy of the system is to be made. The result is stimulated using LABVIEW Software.
REFERENCES


