# Evaluation of Non-Coherent Demodulation of Pi/8 D8PSK with Reed – Solomon Codes

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## ABSTRACT
Errors occur after the transmission, because of noise and intervention in communication channels. Protecting digital information is very important with a suitable error-control code that enables the efficient detection and correction of any errors that may have occurred. Error-control codes are now used in the entire range of communication. New types of codes, called Reed –Solomon have been developed. In this paper the reed–solomon codes in conjunction with non- coherent Demodulation of Pi/8 D8PSK is proposed. RS codes are simulated using Pi/8 D8PSK using MATLAB.

## Keywords:
RS codes, Pi/8 D8PSK, AWGN.

## 1. INTRODUCTION
Errors occur in every communication systems, so it is mandatory to transmit a message and receive the complete information with zero error. If there is an error during transmission, the need of retransmission of message over noisy channel is required [1]. Due to this problem, Forward Error Correction (FEC) is introduced, known as Reed-Solomon codes. In this type of codes, there is no possibility of requiring retransmission in the case of a detected error.

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 [1], [2].

Reed-Solomon codes are the most commonly used in all forms of transmission and data storage for forward Error correction (FEC). However, certain codes like the Reed-Solomon codes can detect the presence of a disastrous error by examining the received message. We will look at the performance of the decoding process which will evaluate the Bit error rate (BER).

This paper is organized as follows Section 2 covers Reed-Solomon codes. Section 3 describes the Matlab simulation process and basic block diagram. Section 4 shows the result obtained from the simulation and discussion are made. Finally, in section 5 conclusions are drawn and future work of this project is outlined.

## 2. REED-SOLOMON (RS) CODE
Reed–Solomon (RS) codes are a class of linear, non-binary, cyclic block codes [1]. It is a linear block code which produces n output symbols from k input symbols. It is capable to recover maximum of (n-k) erasures from any correctively received k output symbols. Because the decoding of RS code operates over the Galois field. Fig. 1 shows Systematic Form of codeword of block code

| | |
|---|---|
| *n – k* parity check bits | *k* message bits |

**Fig. 1: Systematic Form of codeword of block code**

Reed-Solomon codes provide very powerful error correction capabilities; they have high channel efficiency and are very versatile. They are a "block code" a coding technique requiring the addition of redundant parity symbols to the data to enable error correction. Block coding of information is organized so that the message to be transmitted, basically presented in binary format, is grouped into blocks of k bits, which are called the message bits, constituting a set of 2k possible messages[3,[4]. The encoder takes each block of k bits, and converts it into a longer block of n > k bits, called the coded bits or the bits of the codeword. In this procedure there are (n − k) bits that the encoder adds to the message word, which are usually called redundant bits or parity check bits. error-control coding requires the use of a mechanism for adding redundancy to the message word. The data is partitioned into blocks and each block is processed as a single unit by both the encoder and decoder. The number of parity check symbols per block is determined by the amount of error correction required. These additional check symbols must contain enough information to locate the position and determine the value of the erroneous information.

For non-binary codes, the distance between two code words is defined as the number of symbols in which the sequences differ[5],[6]. For Reed-Solomon codes the code minimum distance is given by (1).

$$Dmin = n – k + 1 \text{ ……………………..} \qquad (1)$$

The code is capable of correcting any combination of t or fewer errors, where

$$t = \left[\frac{d_{min} - 1}{2}\right] = \left[\frac{n-k}{2}\right] \ldots \qquad (2)$$

## 3. MATLAB SIMULATION
The simulation process of this project includes implementing the coding and decoding of Reed-Solomon codes through Non-coherent Demodulation of Pi/8 D8PSK scheme using AWGN channel and all of the work was accomplished using MATLAB. Fig. 2 shows the block diagram of the system[7],[8],[9],[10].

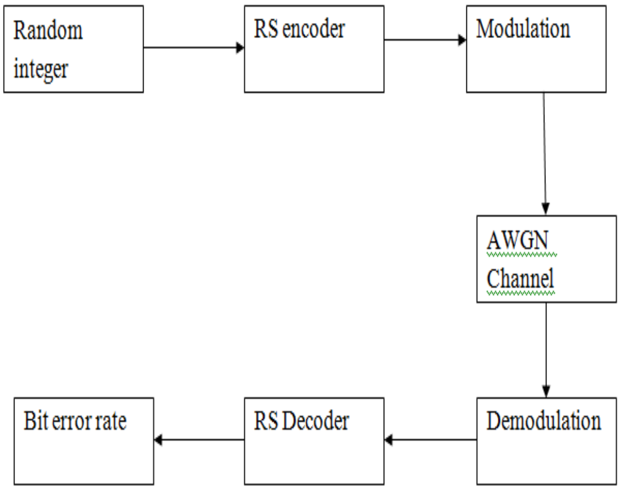


**Fig. 2: Block Diagram of the system**

If there are k- random information symbols as the input message, the channel encoder will map each of the information sequence into a unique n-symbols sequence, known as code-word. This codeword will then passed to the to digital modulator, the type of modulation scheme used .The primary purpose of digital modulation is to map each of the information sequence into signal waveforms. AWGN channel will be the physical medium used to transmit and receive the signal. At the receiver, digital demodulator processes the channel corrupted signal waveforms and reduces it into a sequence of data symbols. 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 depends on the system.

## 4. RESULTS AND DISCUSSION

In this section, the MATLAB function will be verified by simulating an R-S codes for with non- coherent Demodulation of Pi/8 D8PSK AWGN channel. Fig. 3 using non- coherent Demodulation of Pi/8 D8PSK.From the figure, the pink line represents the simulated results of non- coherent Demodulation of Pi/8 D8PSK As shown in Table 4.1, performance comparison in terms of simulated BER non- coherent Demodulation of Pi/8 D8PSK.

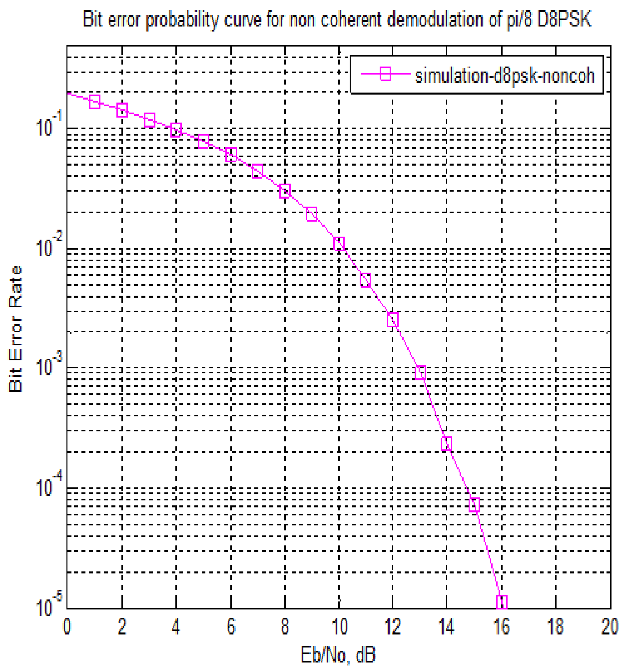


**Fig. 3: BER of R-S non- coherent Demodulation of Pi/8 D8PSK scheme in AWGN channel**

**TABLE 4.1**

BER performance comparison for RS non- coherent Demodulation of Pi/8 D8PSK scheme in AWGN channel

**Results**

| Eb / No | 0 | 2 | 8 | 12 |
|---|---|---|---|---|
| Pi/8D8PSK | 0.1968 | 0.1423 | 0.03083 | 0.000748 |

## 5. CONCLUSION

The proposed program is based on MATLAB simulation to calculate the BER performance of RS codes. As Eb/No increases, BER decreases more for RS non- coherent Demodulation of Pi/8 D8PSK .The major advantage of the differential modulation is its immunity to the missing of the high duration phase coherence.[11],[12] ,[13]

The differential quadrature phase shift modulation gives the best compromise between band efficiency and BER performance.

## 6. FUTURE WORK

1. Use of Interleaver for the performance of RS codes
2. Use of other type of channel

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