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Implementation of COFDM Reed Solomon using TMS320C6713

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ABSTRACT: This sheet research presents the implementation of Coded Orthogonal Frequency Division Multiplexing (COFDM) communication system encoded using Reed Solomon (RS) Coding implemented on TMS320C6713 platform**.** The collaboration of MATLAB integrated development environment (IDE) and Code Composer Studio (CCS) are adopted. The real time implementation is one of the most difficult issues of OFDM implementation. The problem of real time implementation is the memory consumption and the processing time. The other problem is Synchronization of OFDM receiver. Time and frequency synchronization to distinguish the begin of the OFDM symbol. The capability of RS for encoding the error correction ability makes it the most used error correction codes algorithm, so we use it with OFDM systems to combining them make the system has excellent performance potentiality in multipath and fading channels. The bit error rate and the number of error bits are calculated during each test on the system.

Keywords: COFDM, MATLAB Simulink, DSP, CCS, AWGN, Relight fading, Reed Solomon code.

1. INTRODUCTION

The digital scheme that provided high data rates is Orthogonal Frequency Division Multiplexing (OFDM) is by transmitting the parallel carriers simultaneously. Today the new communication systems use this modulation technique because of the need of higher data rate. [2-4].The main advantages of OFDM are its Durability against channel dispersion and ease of phase and channel estimation in a changing environment over time [5]. Inter-symbol interference (ISI) is a substantial problem in high-speed communication is. When the transmission interferes with itself and the receiver cannot demodulate the transmission correctly ISI occurs. The receiver delivers more than a copy of the signal because of the signal suffer from physical phenomena such as reflection from mountains or high buildings. This situation is called multipath. Because the reflected paths take more time to arrive to the receiver, this delayed version of the signal interferes with respect to the direct signal, causing ISI.

As communication systems increase the speed of their data exchange, the time for every transmission fundamentally winds up shorter. Since Multipath delay time remains constant, ISI becomes limited in high data rate communication [6].

COFDM prevent that issue by transmit Many lower speed transfers are combined. High data rates can be executed in COFDM with aid of transmitting a number of orthogonal sub-carriers [7]. Therefor COFDM was suitable for high-speed conversation because of its avidness to ISI. The other issue is fading channel, the deep fading of the signal caused by delayed version of the reflected signals. The strength of the signal is low, so that; the receiver cannot decide correct sample [8]. OFDM has been ended up being a successful strategy to battle multipath blurring in wireless channels [10]. Other than implementation flexibility, minimize complexity required in transmission and receiver as well as the attainable high performance renders OFDM a highly attractive candidate for high-information-rate over time-varying frequency-selective radio channels [11].

Coding in OFDM structures are capable to gain high-quality overall performance on frequency selective channels due to the fact of the blended advantages of multicarrier modulation and coding [12, 13]. The most widely used coding for non-binary symbolic is Reed Solomon or [14]. RS coding technique has the capability to correct randomized errors, as nicely as many random bursts of errors, for this motive RS Codes are famous in many realistic systems [15].

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2. COFDM SYSTEM MODEL

The entry to the system is encoded the use of a (n, k) RS code. The encoded stream of length n is mapped to QPSK complex symbols.in our suggested system the Pilot symbols are inserted as comb-type pilot based arrangement as shown in Fig. 1 [3]. Thereafter, the application of stander OFDM transmission systems first the data stream bass through the Serial-to-Parallel (S/P) conversion, after this the signal bass to IFFT, Parallel-to-Serial (P/S) conversion, cyclic prefix insertion, and Digital-to-Analogue conversion (DAC). At the receiver the signal first bass to the Analogue -to- Digital convertor (ADC), removing cyclic prefix, Parallel-to-Serial (P/S) .after the channel the following steps are performed. Subsequently, the pilot symbols are removed in order to estimate/compensate for the channel fading effect. The compensated received signal is hereby fed into the RS decoder which outputs the decoded message. The OFDM-RS system model is therefore expatiated as follows.

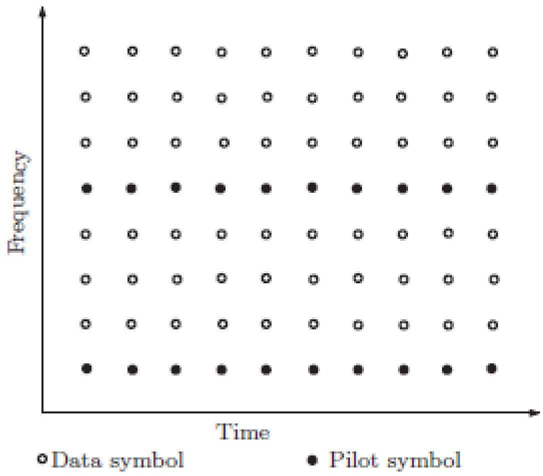

FIGURE 1: Comb-type pilot arrangement

3. IMPLEMENTATION OF RS CODED SYSTEM

Fig. 2 shows the implementation of the suggested model. The parameters of designed system are shown in table (1-1). The input data will be generated using Bernoulli Binary Generator block in Simulink library with 44 samples per frame. The data encoded using Reed-Solomon (RS) encoder with (15, 11) code length. The data modulated by using QPSK Modulator Baseband block.

The pilot sequences are added to the modulated streams and zero padded added too.

When IFFT process is completed, the cyclic prefix will be added. In this model a 40% cyclic prefix will be used to overcome the ISI, ICI. The cyclic prefix addition will be done by copying the last part of the signal and merging it in the beginning. Then the symbol passed to training insertion that duplicated the symbol Fig. 3 show the s block of training insertion.

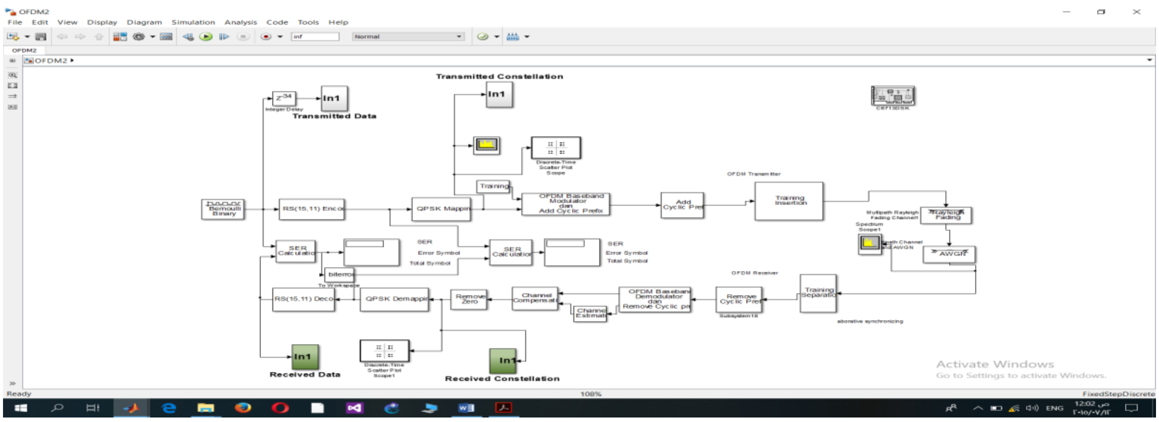

FIGURE 2: Reed Solomon COFDM System Design through rayligh fading and AWGN channel.

Table (1-1) Reed Solomon encoded OFDM parameter

Parameter	Value	Unit
Number of transmitted bit	10^8	Bit
Sampling frequency	100	KHz
Bandwidth	50	KHz
FFT/IFFT (N-point)	64	Point
Subcarrier spacing	277.8	Hz
Cyclic prefix	26	Sample
Modulation	QPSK	----
Doppler shift	20	Hz
Symbol period	3.6	$msec$

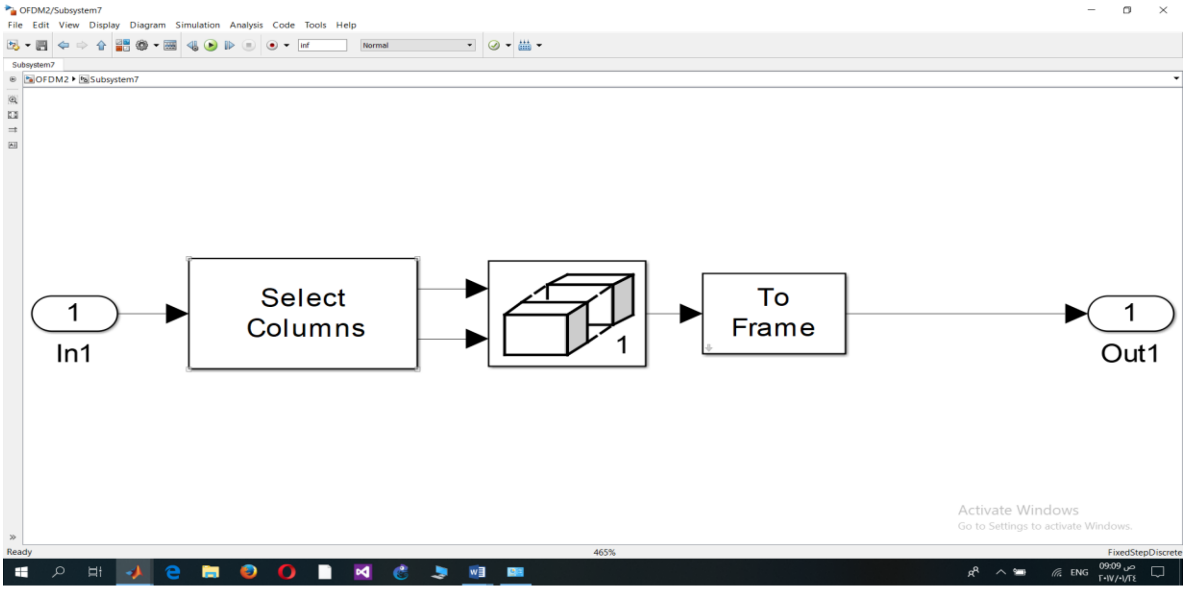

FIGURE 3: S-block of training insertion

The signal is transmitted over Rayleigh fading and AWGN channel. At the receiver, the first stage is training separation to restored OFDM. Next step will be removing the CP after that the data pass to (FFT) then remove the pilot sequence then it passes to channel estimator to drive the coefficient of the channel. In this system the least square method has been used is the most common one with low complexity .Where the received data is divided by the transmitted one at each pilot location to get estimated channel component at that location. The block used for this method is shown in Fig. 3, Fig. 4 and Fig. 5 first pilot will be generated similar to the pilot that generated in the transmitter, after that the pilot compare to the pilot in OFDM symbol to estimate the channel response. The useful information will be demodulated to pass through the baseband demodulator. After demodulated the stream would be decoded using RS

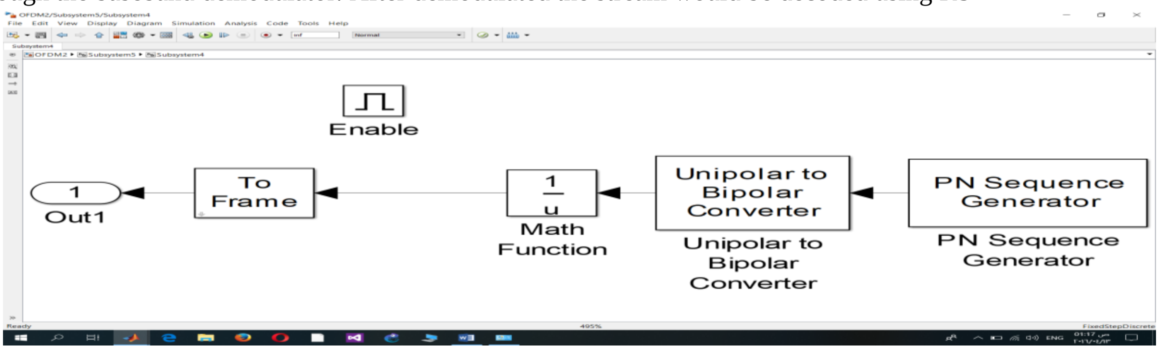

FIGURE 4: Generate pilot in channel estimator

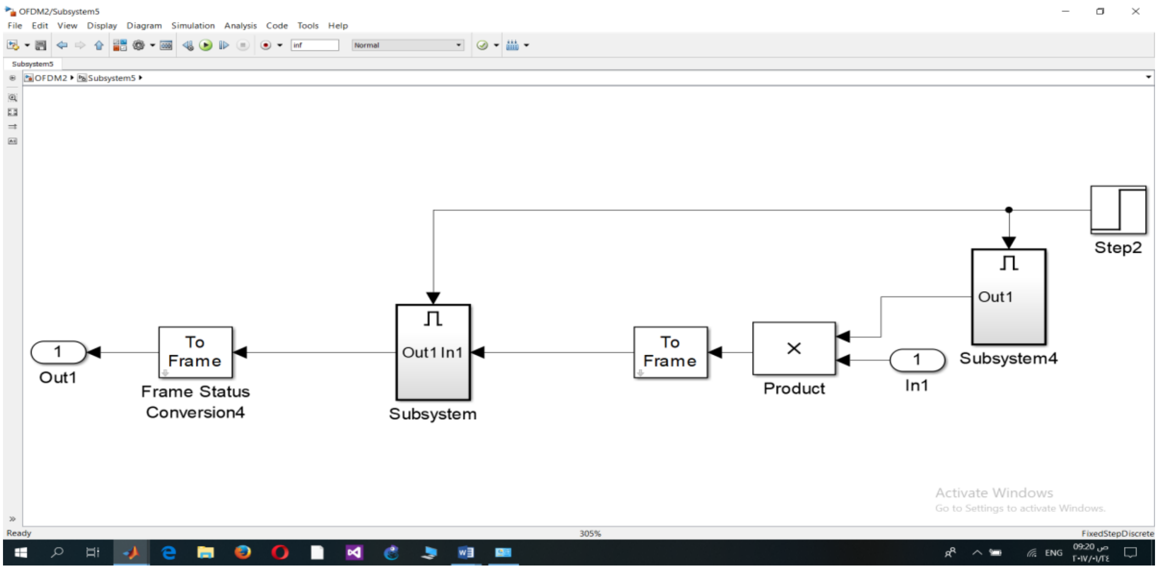

FIGURE 5: Channel estimator

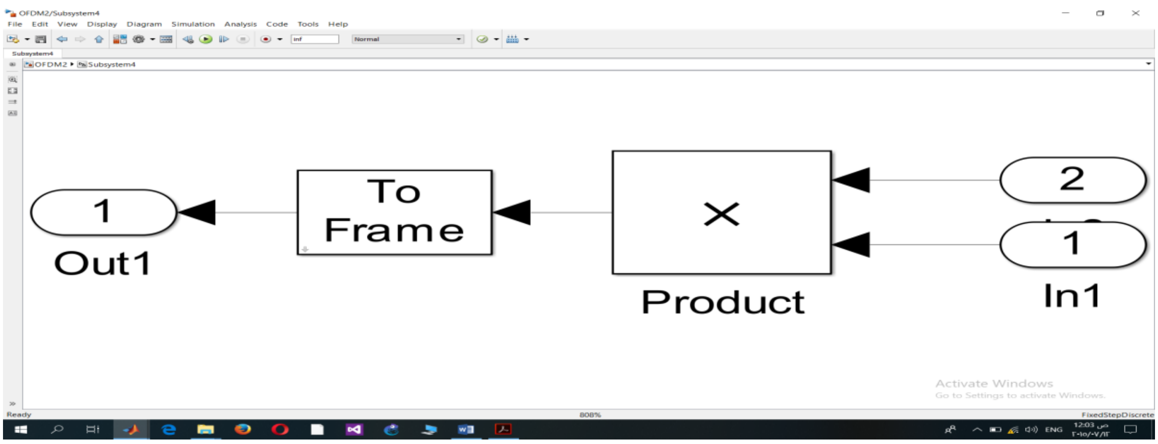

FIGURE 6: Channel comparator

4. LOADING CODE TO TMS320C6713

The TMS320C6713 platform, similar to any PC, needs to load programs to set up its behavior and function. This program can be composed in a collection of methodologies. The design approach which we use is shown in Fig. 7. The following stages explain the model which is constructed from large collection Simulink's block sets. If a specific block required is not included in Simulink’s block sets, the designer must write their own blocks from scratch using MATLAB. The design is still now not operating on any specified hardware. To implement that the architect utilizes the C6x Target and Read to Write (RTW) to produce (or fabricate) American National stander institute ANSI C code planned for the TI C6713 DSK. After that the C6x target automatically take the produced ANSI C code and uses the TI CCS tools to compile specific machine code and finally loads machine code to the target of the TI C6713 DSK hardware.

RS CODED SYSTEM RESULT

The simulation results of RS COFDM system is taken for CFO=20Hz, while STO= 0 sample. The spectrum of the suggested block interleaved COFDM with T_s of 10^{-5} sec, using 16 pilots is shown in Fig. 8. Transmitter constellation of the system is shown in Fig. 9. The received constellation of the COFDM system is shown in Fig. 10.

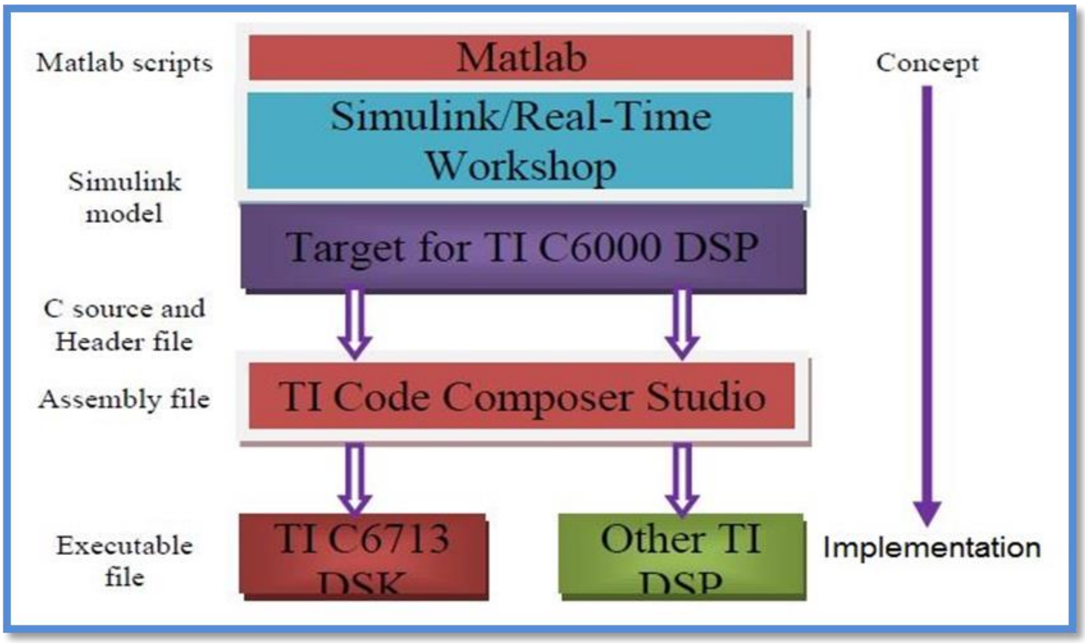

FIGURE 7: Programming configuration stream [9]

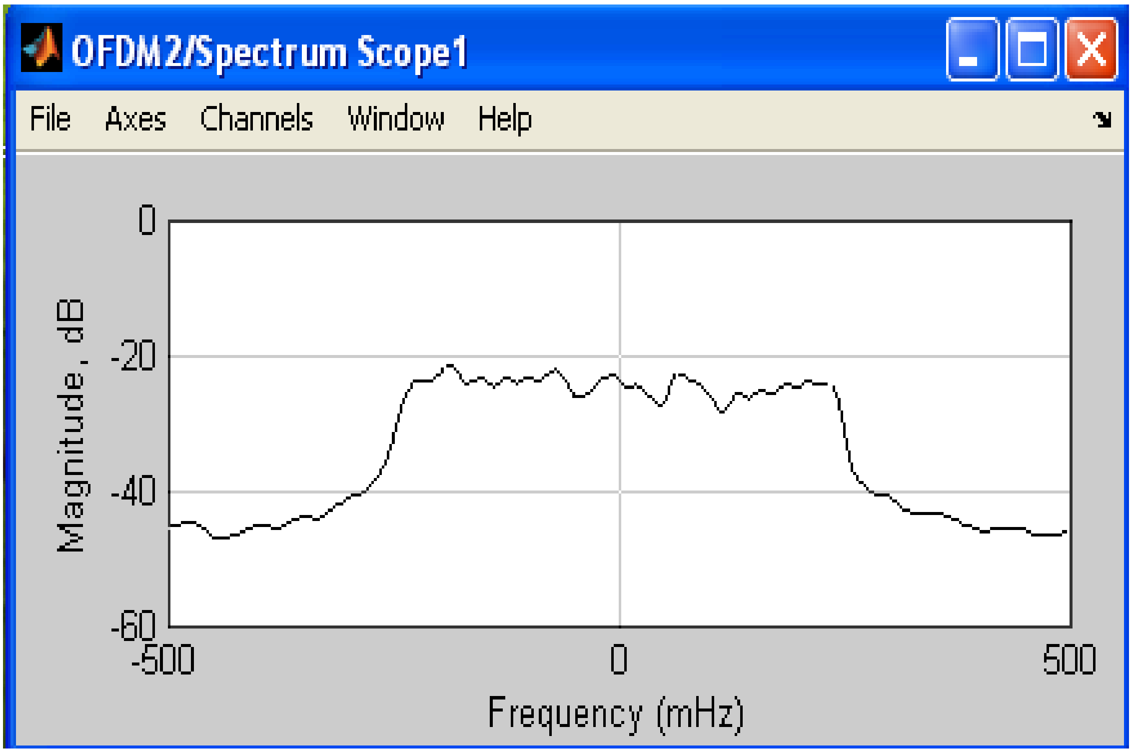

FIGURE 8: Spectrum of the received signal of RS COFDM system over Rayleigh fading and AWGN channel

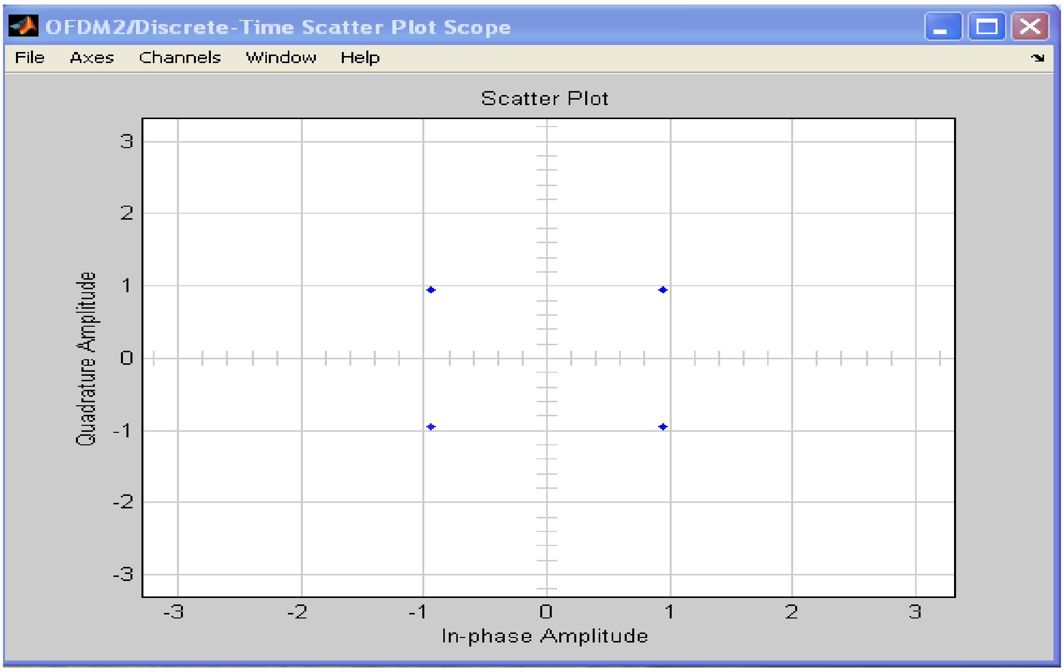

FIGURE 9: Constellation of transmitted signal using QPSK of R.S COFDM system over Rayleigh fading and AWGN channel

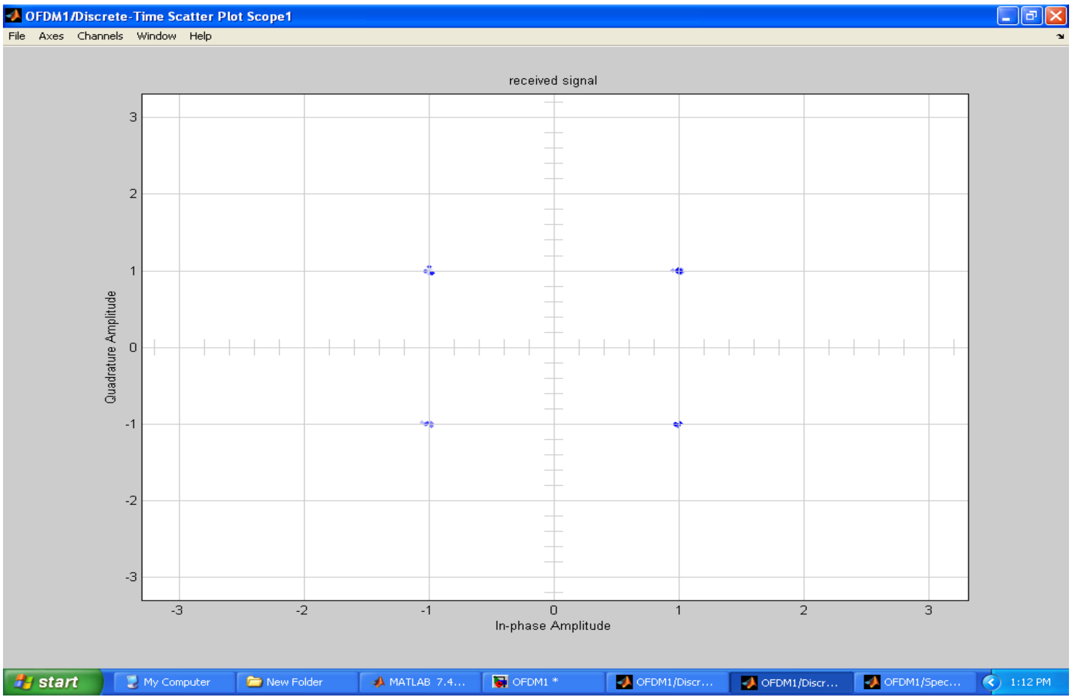

FIGURE 10: Constellation of received signal using QPSK of R.S COFDM system over Rayleigh fading and AWGN channel

The performance over outdoor channel with Doppler shift=20Hz is shown in Fig. 11. The Bit Error Rate BER is plotted against SNR which compares coding OFDM system.

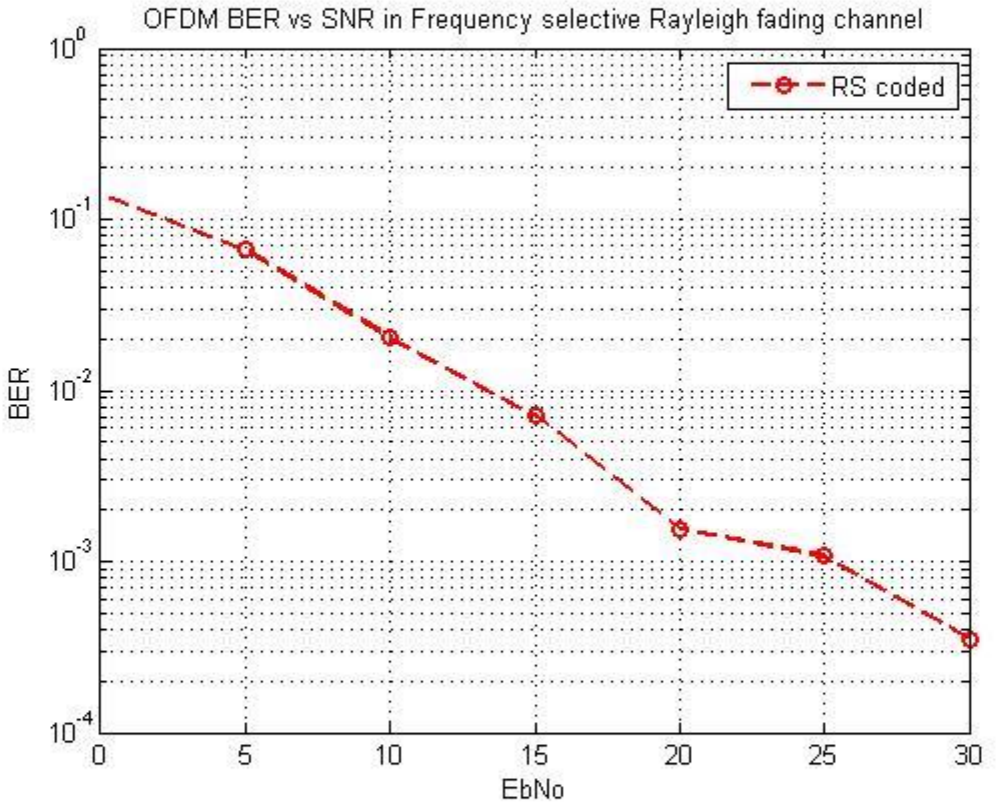

FIGURE 11: f BER for RS COFDM system over rayligh fading channel

CONCLUSION

From the result ,we noticed that OFDM has better execution over single-carrier QPSK in fading channel and AWGN channel as shown by the BER rates .With the Reed Solomon Coding , we can see that the OFDM system will have a higher exhibition over fading and AWGN channels .We found that OFDM with between adjustment QPSK is superior to OFDM with between regulation 16-QAM as shown by bit blunder rates (BER) , where the BER of OFDM with between tweak QPSK is low and with coding nearly ways to deal with zero . Future research might be founded on this paper. These expansions may incorporate channel estimation, cyclic prefix, channel stage move location and revision, crest to average power proportion contemplations and DSP implementation.

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