ISSN XXXX XXXX © 2016 IJESC

Research Article Volume 6 Issue No. 8

Binary Phase Shift Keying Modulation and Demodulation Simulation in Matlab

Awadhesh Kumar Singh[1], Nar Singh[2]
Research scholar[1], Professor[2]
Department of Electronics & Communication
University of Allahabad, Allahabad, Uttar Pradesh, India

Abstract:
This paper presents the implementation of Binary Phase Shift Keying (BPSK) modulation and demodulation in MATLAB Simulink environment. The main aim of the communication system is accurate transmission and reception of data/signals. The selection of modulation and demodulation techniques depends on the low Bit Error Rate (BER), high data rate, small power requirement and design simplicity. The BPSK modulation and demodulation technique is widely used in many areas because of it satisfies most of the above criteria. The BPSK modulated signal is produced by modulating carrier according to the Bernoulli binary code generator and by noisy Additive White Gaussian Noise (AWGN) channel. The demodulation is performed in different demodulation techniques like using Integrate and Dump filter, low pass filter and BPSK Demodulator block with suitable block parameters.

Keywords: ASK, AWGN, BER, BPSK, FSK, PSK, MATLAB, SIMULINK.

I.INTRODUCTION

In past the analog communication systems were in use. These systems have disadvantages like more expensive, consume more power and less repeaterless distance. For long distance communication more amplifiers are required to amplify the signal. But these amplifiers also amplify noise. These disadvantages lead to use digital communication systems which are more reliable, cost effective, flexible, easily modified and easy to recover. The digital modulation schemes are as Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), and Frequency Shift Keying (FSK) etc. The PSK is widely used in existing techniques because it is best in binary schemes. The Binary Phase Shift Keying is generally used for biometric passport and for satellite communication. This paper explains the BPSK modulation and demodulation in detail and designed a complete model of digital communication using BPSK Modulation and demodulation in MATLAB environment. In demodulation three techniques are used.

(a) Using Integrate and Dump Filter.
(b) Using Low Pass Filter.
(c) Using BPSK Demodulator block.

II. BPSK Modulation

In Binary Phase Shift Keying modulation the phase of fixed amplitude sinusoidal carrier is varied in accordance with the binary data. It has one fixed phase when data bit is at one level and when the data bit is at other level the phase differs by 180^o. The data bit stream base band signal b(t) and the transmitted signal will be as follows.

The BPSK modulated signal is given as
$V_{BPSK}(t) = b(t)\ A\ \cos(\omega_0 t)$

Where b(t) = 1 for bit '1' and -1 for bit '0'

The BPSK modulated signal is generated by using carrier to a balance modulator as shown in Fig. 1.

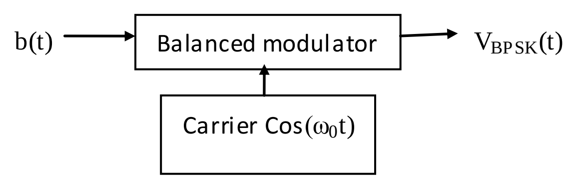

Fig. 1: BPSK Modulator

This modulated signal is transmitted through AWGN channel and after reception of base band signal some error is found. This error is calculated as:

$$P_e = \frac{1}{2}\,\mathrm{erfc}\sqrt{\frac{Es}{\eta}}$$

III. Matlab Simulation of BPSK Modulation

The BPSK modulation is implemented in Matlab simulink with the use of bit sequence generator as input signal of bit stream fed to the switch which compares the threshold level of signal coming with two sine wave carrier in apposite phase and same frequency. The output of switch is fed to the scope which shows the modulated signal. The block diagram is shown in fig. 2(a) and simulated results are shown in the fig. 2(b).

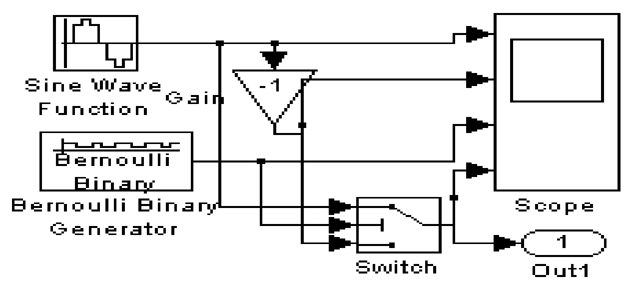

Fig. 2(a): Block diagram

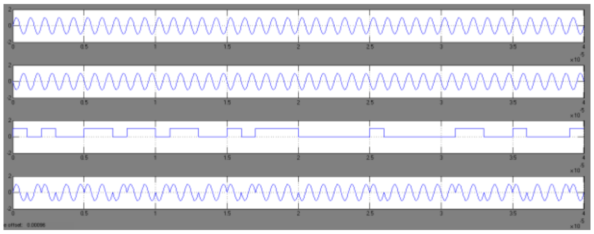

Fig. 2(b) Simulated Results

IV. BPSK Demodulation using Integrate and Dump filter

The modulated signal is transmitted through Additive White Gaussian Noise (AWGN) channel where a noise is add to signal. The noisy signal is fed to the saturation block. The saturation block imposes upper and lower bounds on signal This saturated signal is then multiplied a synchronous carrier with same phase and frequency as that of received signal, then fed to integrate and dump filter block with suitable parameters which create a cumulative sum of the discrete-time input signal, fed to the control input to compare with data inputs of switch block. Criteria for passing the first or third input the control input condition sets as required output of modulating signal of binary sequence. The simulation block diagram shown in fig. 3(a) and simulated results are shown in fig.3(b).

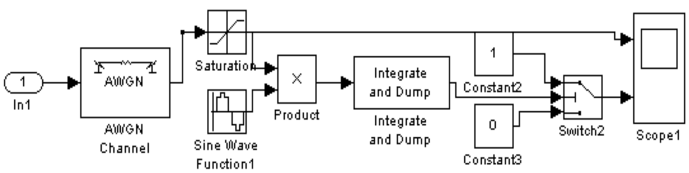

Fig. 3(a): Block diagram

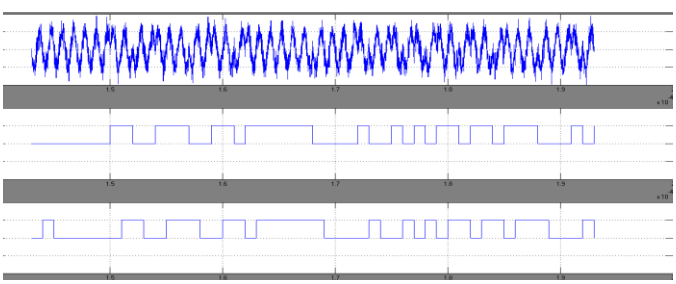

Fig. 3(b): Simulated results

V. BPSK Demodulation using low pass filter

In this demodulation process low pass filter is used in place of integrate and dump filter. The low pass filter is used in finite impulse response (FIR) with suitable block parameters and design method with Kaiser Window. All other blocks used are same. It is found that errors are more in this case.The simulation block diagram and simulated results are shown in the fig. 4(a) and fig. 4(b).

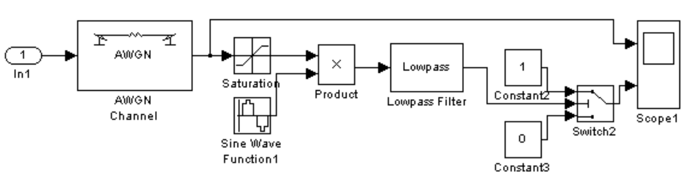

Fig.4(a): Block diagram

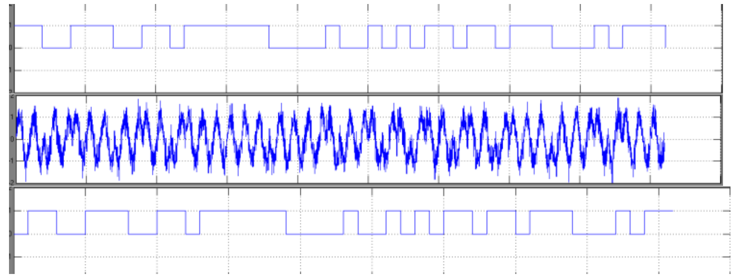

Fig.4(b): Simulated results

VI. BPSK demodulation using BPSK demodulator block

The fig. 5 shows BPSK modulator base band signal with Bernoulli sequence generator fed to the AWGN channel with SNR of 10 dB and BPSK baseband demodulator with suitable block parameters. It is compared the input binary sequence and demodulated output by using error rate calculator block. The output plots are shown in fig. 6. The BER plots of theoretical and Monte Carlo method are shown in fig.7. From the plot it is found that up to 12dB of the SNR value the errors of 11 bits in the transmitted symbols of 1e8. The comparison between theoretical and Monte Carlo are similar up to 11 dB.

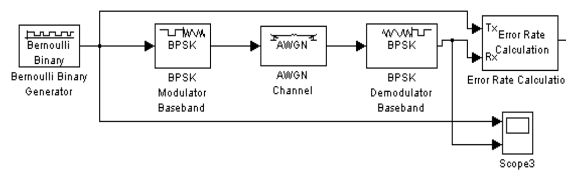

Fig. 5: Block diagram

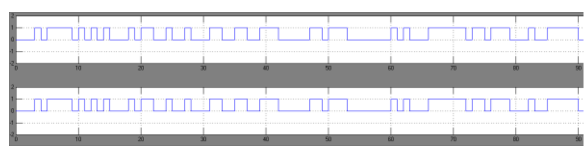

Fig. 6: Simulated results

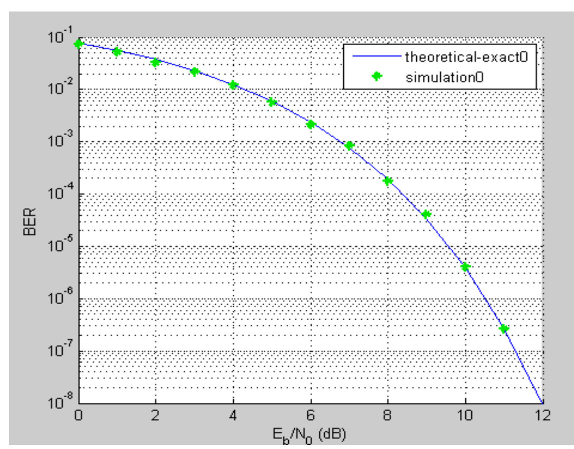

Fig. 7: BER plots

VII. Conclusion

This paper presents the MATLAB Simulation of BPSK modulation and plotted all the wave shapes with AWGN channel of 10 dB SNR and demodulated by using three different demodulation techniques ie. Integrate and dump, Low pass filter and BPSK demodulator block. It is found that the coherent detection of base band binary sequence is delayed by about 1 micro seconds and the bit error rate of about 0.5%

when using Integrate and Dump or low pass filters. But by using BPSK demodulator block of Matlab it is found that there is no delayed output and bit error is found 11 bits in 1e8 no. of symbols. In figure 7 it is seen that the plot of theoretical and Monte Carlo simulation graph of BER Vs Signal to Noise ratio are found same.

VIII. REFERANCES

[1] Taub, Schilling, "Principles of Communication Systems" Second edition, Tata McGRAW-HILL Publishing Company limited, New Delhi.

[2] Simon Haykin, "Communication Systems", Fourth Edition, John Wiley & Sons (Asia) Pte. Ltd.

[3] Bernard Sklar, Pabitra Kumar Ray, "Digital Communications, Fundamentals and Applications", Second Edition, Pearson, Education, Inc 2001.

[4]J .G. Prokis, "Digital Communications", Fourth Edition, Mc Graw Hill, New York, 2001.