MATLAB Simulation To Confirm B.E.R. in Line Coding Techniques & Phase Shift Keying Techniques

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Abstract

There are multiple ways to transmit data from a transmitter to receiver. For instance, modulation, coding etc. In this research article, our aim is to compare a line coding technique and a phase shift keying modulation technique to understand how they operate and when to use them.

Introduction

Line coding is a technique to code any given data. Line coding is used to avoid signal overlapping and distortion. In addition to this, bandwidth is efficiently used along with power. A long string of repetitive data can be easily decoded at the receiver end , for example a string of 1's .

Modulation is another technique to transmit data. In modulation a high frequency signal has its properties changed with respect to the data, the high frequency signal is known as the carrier and has to be demodulated at the receiver end .

Both these methods will be compared in this project. We will implement Polar NRZ code using Simulink and study its transmission. In addition to this, we will implement BPSK Modulation scheme and compute the BER.

Implementation

The implementation of this project is divided into two parts

Line code (Polar NRZ)

In a polar NRZ waveform, the output wave signal takes two states. A positive voltage value for binary '1' and negative voltage value for binary '0'.

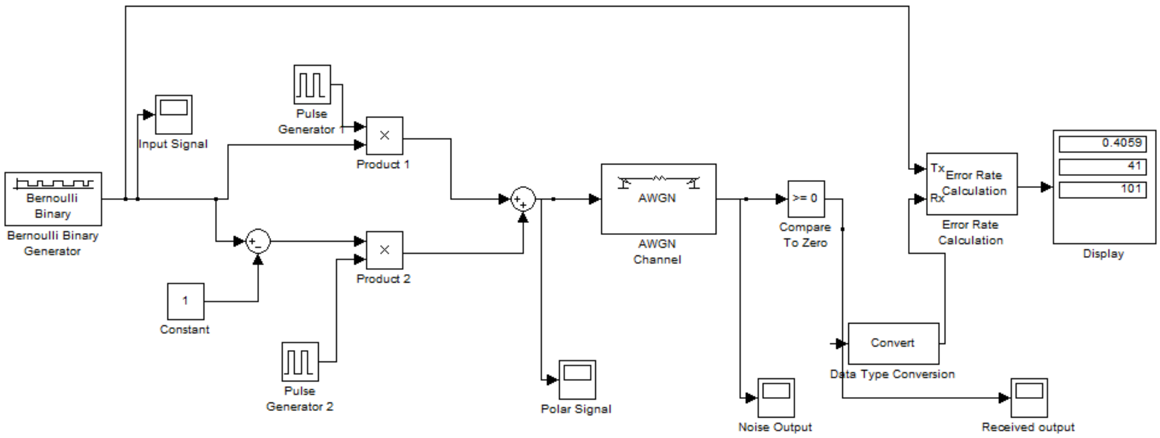

FIG. 1: Simulation Model for Polar NRZ transmission

In the model shown in Fig. 1, a Bernoulli binary Generator is used to generate binary data. This data is split into two parts the upper half and lower half. The upper half is obtained when the given signal is multiplied with a string of pulses (with amplitude ‘1’). For the lower half, the given signal is subtracted from unit step (constant) and multiplied with a pulse string (with amplitude ‘1’). In both the halves, the pulse width is set at 99.99%.

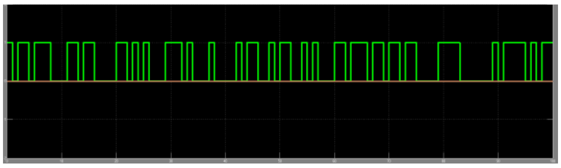

FIG. 2: Input Signal (data)

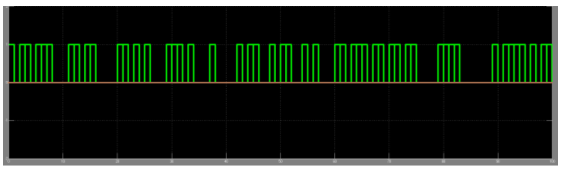

FIG. 3: Upper Half (after product 1)

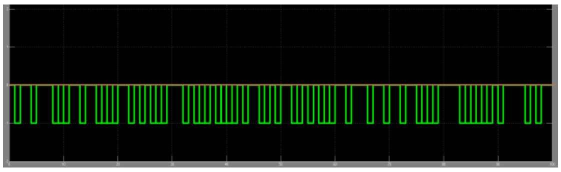

FIG. 4: Lower half (after product 2)

The addition of both these waveforms gives us the Polar NRZ waveform shown in FIG. 5

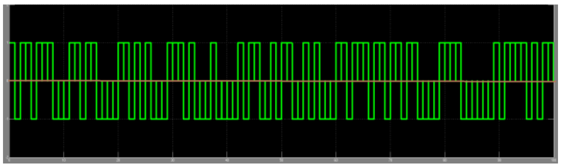

FIG. 5: Polar NRZ waveform

To understand effect of noise on polar line code, we add this output to White Gaussian noise block. This Noise block is set at 10 Variance from mask. Now this output is compared to ‘0’ i.e. anything above 0 will be assigned a positive voltage and anything below 0 will be assigned a negative voltage.

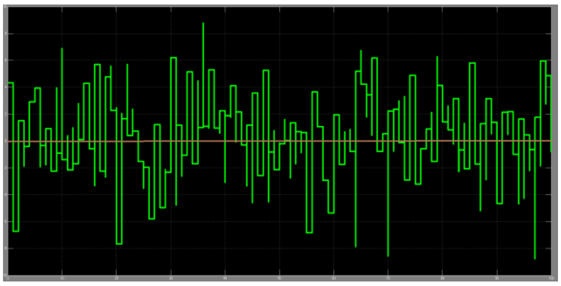

FIG. 6: Output with noise

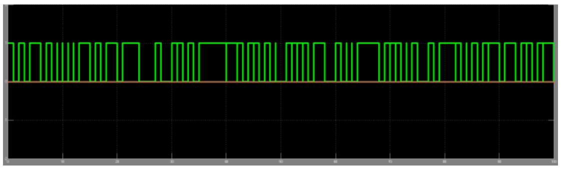

FIG. 7: Final output

BPSK

Binary phase shift keying is a method in which two carriers with same high frequency but opposite phase are used to modulate data. In this project we use BPSK modulator and demodulator blocks directly.

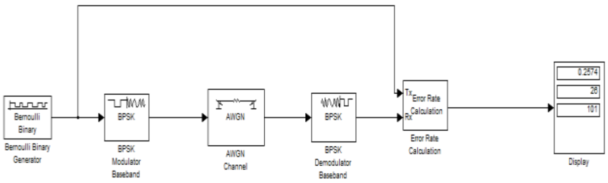

FIG. 8: Simulation Model to Compute BER in BPSK

This simulation is for a period of 100 seconds with the Variance from mask set as 10 in the AWGN block. In the display block (FIG. 12), the first value (i.e. ‘0.25’) is the BER. The second value is error received (i.e. ‘26’) and the third value is bits compared (i.e. 101) .

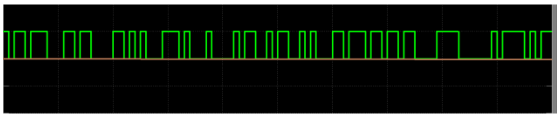

FIG. 9: Transmitter output

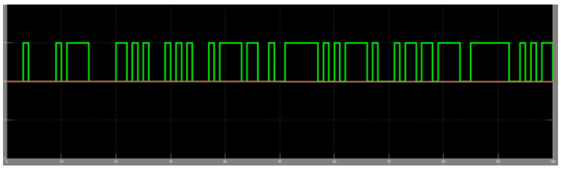

FIG. 10: Receiver output

Result

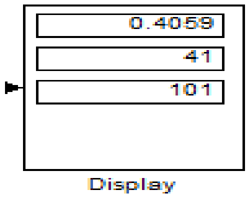

FIG. 11: Display Block for Polar NRZ

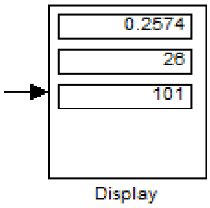

FIG. 12: Display Block for BPSK

We observe that in case of line codes, the waveform is not very immune to noise, this is known from checking the BER value of 0.4059, but in case of BPSK, the BER is 0.2574.

In any system if the BER is Zero, it means that the transmitted input and received output are same

Conclusion

From this project we conclude that line codes must be used when the transmitter and receiver are nearby and the intensity of noise is less i.e. SNR value is high. But in case of large distances BPSK is suitable, since data is not corrupted by noise easily.

Generation of line codes require less power and utilizes bandwidth efficiently. Conversely in BPSK power required is comparatively more and the circuit required is difficult to fabricate.

References

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