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Comparative Evaluation of Bit Error Rate (BER) in UWB

[1] Sheetal Mungale, [2] Neelesh Gupta

[1] M-Tech IV[th] SEM (D.Comm.), TRUBA,
Bhopal, M.P., India

[2] Asst. Prof, Department of Electronics Engg, TRUBA
Bhopal, M.P., India

Abstract - UWB (Ultra Wide Band) technology is a reliable transmission scheme for wireless communication with high data rates. It is called as impulse radio, impulse radar or carrier free ultra high resolution .UWB occupies a bandwidth of more than 25% of a center frequency, or more than 1.5GHz . It is a carrier free (base band) technique, which will greatly reduce the complexity and cost of transceiver. UWB can be characterized with ultra short duration pulses called monopulse which has excellent immunity in interference from sensitivity or multipath effects or fading problem. In this paper we examine different types of pulse shaping, modulation techniques and different types of demodulation are simulated and evaluated the BER(bit error rate) in the presence of the AWGN (additive white Gaussian noise) . In this paper BER are Compared to examine the best modulation technique with monopulse.

Keywords **– UWB, BER, Gaussian Pulse, Monopulses.**

1. Introduction

UWB is a newly developed wireless RF technology, and is considered to be a potential solution to a wide range of RF problems. The UWB may be promising technology for next generation communication, especially for high data rates and short range applications. We could use it to send a lot of data ,very far ,very fast ,for many users and all at once.

2. Modulation Scheme

In general modulation process is used in communication system to smooth the spectrum of the signal. Modulation process prevents the system from interference to the existing narrowband and wideband signals. UWB implementations can directly modulate an "impulse" that has very sharp rise time and fall time ,thus resulting in a waveform that occupies several GHz of bandwidths. Impulse communication does not use a modulated sinusoidal carrier to convey information, but instead this modulation scheme consist of very short duration pulses called monopulses.

Three modulation schemes are :

1.OOK(On Off Keying)
2 .PPM(Pulse Position Modulation)
3.BPSK(Binary Phase Shift Keying)

2.1 OOK Modulation

In OOK modulation scheme data symbol indicates "1" the presence of a pulse and data symbol "0" indicates no pulse.

On –off shift keying data modulation can be expressed as

$$s^{(k)}(t) = \sum_j d^{(k)} w(t - jT_f)$$

OOK using Gaussian first derivative

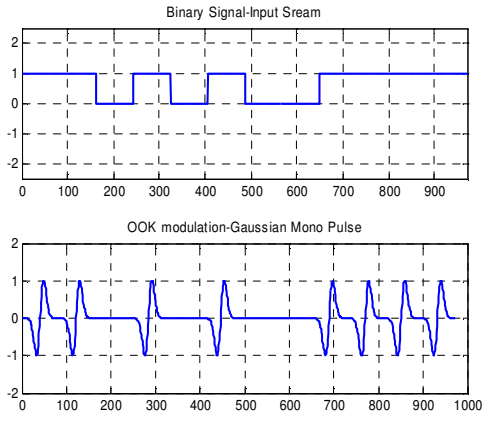

Fig 1. Gaussian first OOK modulation

OOK using Gaussian Second Derivative

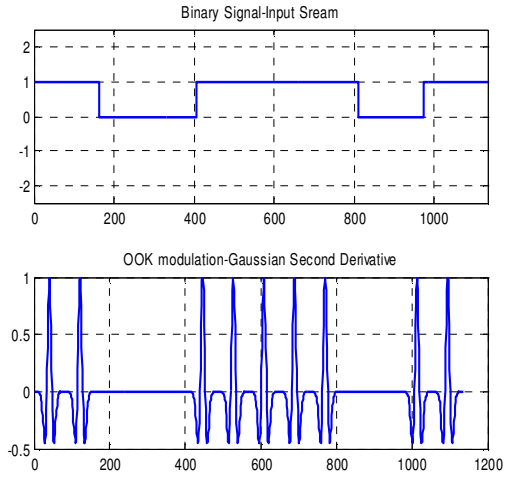

Fig2. Gaussian second OOK modulation

2.2 Pulse Position Modulation

In pulse position modulation pulse position data modulation can be expressed as

$$s^{(k)}(t) = \sum_j w(t - jT_f - c_j^{(k)}T_c - \delta d^{(k)}_{[j/Ns]})$$

where, *c*j is the time hopping code sequence, with an additional time shift of *cjTc* to the j^{th} pulse. D is the modulation factor indicates data symbol "1" for each additional time shift and "0" without any additional time shift. $d^{(k)}$is the binary (*0 or 1*) symbol stream data sequence with *k* transmitter-dependent quantities. For a fixed frame T_f, the binary symbol rate *Rs* determines the symbol, using the equation symbol, using the equation Ns of pulses that are modulated by a given binary symbol, using the equation *Rs=1/Ts=1/NsTf*

PPM using Gaussian First Derivative

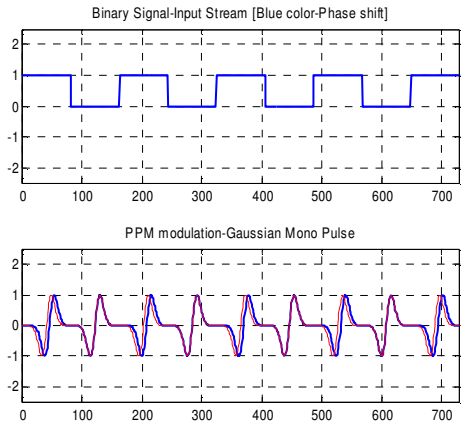

Fig.3.Gaussian First PPM Modulation

PPM using Gaussian Second Derivative

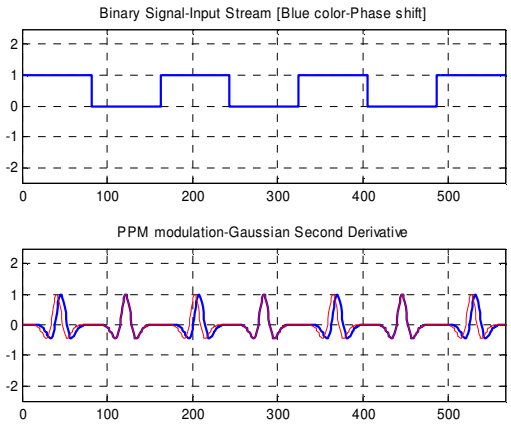

Fig.4.Gaussian Second PPM Modulation

3. Binary Phase Shift Keying

In BPSK modulation scheme the data is carried in the polarity of the pulses .The phase value of zero degrees indicate the data symbol "1" and 180 degrees phase value indicate the data symbol "0"

BPSK data modulation can be expressed as

$$s^{(k)}(t) = \sum_j w(t - jT_f - \phi)$$

BPSK using Gaussian First Derivative

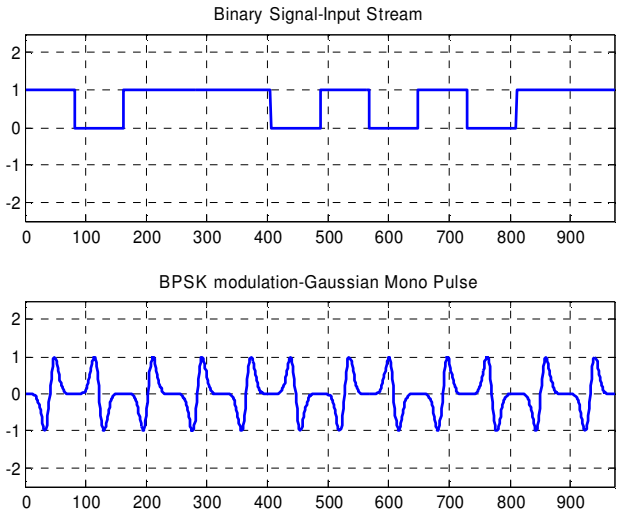

Fig.5.Gaussian First BPSK Modulation

BPSK using Gaussian Second derivative

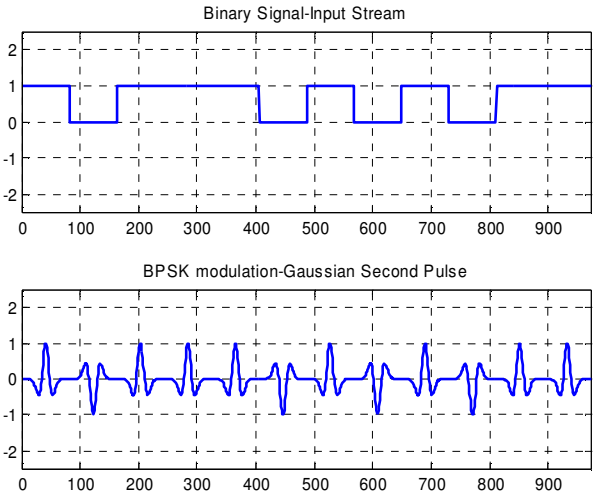

Fig.6.Gaussian Second BPSK Modulation

The signal will again have AWGN channel noise added to represent real life conditions, which will show up at the receiver side. The AWGN Channel represents an idealized channel for UWB transmissions. A threshold was used to convert the analog signal to binary, which was accomplished using the digitize function.

The digitize signal was then given to Demodulate function which is also known as hard decision decoding [2] For best results, the threshold should be set to 0.5 for optimal decision criterion. Again, the simulation BER are calculated for each SNR interval.

4. Simulation Result with different Modulation and Gaussian First and Second Derivative Pulse for UWB System

In this paper, three different modulation schemes and two different pulse shaping techniques are chosen carefully and their effects are investigated in the presence of UWB technology by using bit error rate (BER) technique.

The BER is well-accepted performance test for traditional wireless communications schemes for different modulation techniques in UWB technology, a comparison is also made with the presence of AWGN.

a) BER for Gaussian first Derivative

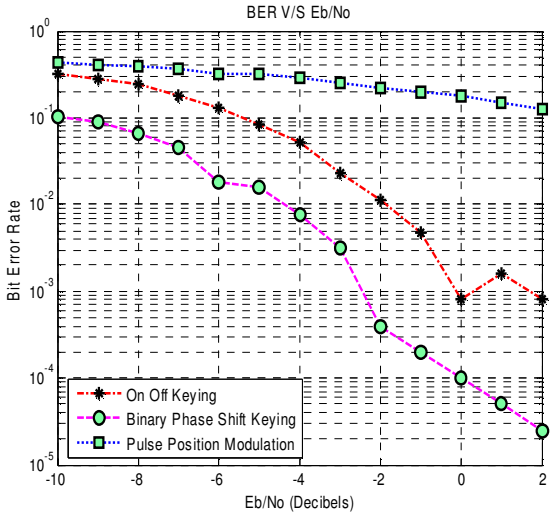

Figure.7 BER for Gaussian first Derivative

b) BER for Gaussian Second Derivative

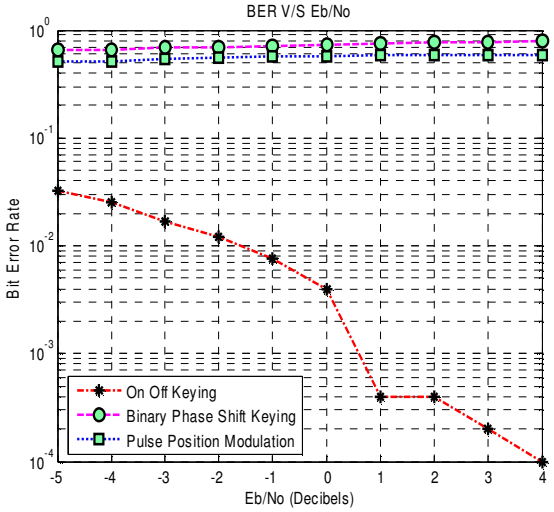

Figure.8 BER for Gaussian Second Derivative

5. Conclusion

This study is focused on the basis of UWB such as pulse shaping and the modulation schemes. To fulfill the objective of the study two different types of pulse shaping and three different types of modulation schemes for UWB system are considered for performance evaluation. By considering of pulses and three different types of modulation techniques the BER (bit error rate) performance of the modulation techniques will be evaluated in the presence of the AWGN .Simulation techniques are used and comparisons are made for Gaussian first and Second Derivative pulse modulation schemes using BER performance evaluation in the

presence of AWGN channel for UWB. The results show the BER performance of BPSK modulation scheme to be the best in AWGN channel as compared to the other two modulation techniques considering Gaussian first derivative pulse and the the BER performance of OOK modulation scheme to be the best in AWGN channel as compared to the other two modulation techniques considering Gaussian second derivative pulse.

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