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RESEARCH ARTICLE

On the Suitability of Two Different Pulses for UWB Indoor Localization

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ABSTRACT

Indoor localization system (ILS) is the method of finding out the position of the object, people, and equipment etc in the indoor area system. The ultra-wideband(UWB) system is a favourable solution for high data rate in wireless communication for the purpose of Localization. The UWB transmission scheme proposed two major approaches that are single band approach and multiband approach. Here in this paper, the two pulses(Gaussian and Rectangular) are taken into consideration for ILS. Both these two received pulses under go the operation of averaging and correlation with that of the original transmitted signal for getting the time of arrival (TOA)data in order to locate the position of target in the indoor area system.

Keywords: ILS, Localization, TOA, UWB, Correlation

INTRODUCTION

Now a days the utilization of wireless communication increases rapidly,so the requirement of high data rate also increases,for this there is a need increased data rate capacity, which can satisfy the user's demands fruitfully.The data rate can be increased by increasing the signal bandwidth.The ultra-wideband (UWB) is a type of wireless technology, which plays a vital role in the field of localization for its several features like wide spectrum that is the frequency range is 3.1GHz-10.6GHz, the duty cycle is very less that is maximum on time 5ms to off time 38ms, the ranging accuracy is very high (cm), the pulses used are very small (ns), ability of penetration to the obstacles, capable of avoiding the multipath fading etc. The Federal Communications Commission (FCC) has assigned (In February 2002) the spectrum in range 3.1 GHz - 10.6 GHz as unlicensed indoor UWB application and also defined as this signals having -10 dB bandwidth is higher than 500 MHz [1-4]. Generally the UWB transmitters operate by dispatching billions of pulses through a large spectrum having 7.5GHz wide bandwidth. Modern UWB systems use two technical proposals, one is divide the total of 7.5 GHz spectrum through some 528 MHz bands, which allows the proper execution of bands in definite frequency ranges, on the other hand leaving the rest portions of the spectrum remain unused and other is introducing OFDM modulation scheme and is referred to as UWB-OFDM or multi-band orthogonal frequency division multiplexing (MB-OFDM), which can be contemplated as strong applicant for high-speed WPAN standardization, which come up with high data rate without ICI and ISI technology[5-8]. In this technique, due to the overlapping of sub channels, hence the transmission rate also increases. The requirement of modulators and filters at the transmitter side and similarly the demodulator and complementary filter at the receiver side can be reduced by advanced digital signal processing applications like implementation IFFT and FFT method for modulation and demodulation operation, which make the system more efficient [9].This paper includes the Gaussian pulses and Rectangular pulses for finding out the channel area for the purpose of localization in Indoor area system. The main objective is to look over the distance value for localization in Indoor area system by considering the Gaussian pulse and Rectangular pulse signal in a typical Indoor area system. The distance of a target is estimated by the time of flight (ToF) calculation that can be obtained from a correlation receiver and use this information to identify the channel type the device is operating in.

LITERATURE SURVEY

The ultra-wide band communication technology acts as an emerging technique for the high data rate, low range wireless communication. The UWB transmission scheme proposed two major approaches that are single band approach and multiband approach. Each approach has some merits and demerits .To nullify the limitations of single band technique the multiband were taken into consideration. In this technique rather than taking the total spectral range of UWB for transmission of the information, divide the UWB band in sub bands. Each of the sub bands takes a range of bandwidth of more than 500 MHz. the information has transmitted through the different sub bands at different instant of time. The main advantage of multiband approach is information has to be operated on a very small range of bandwidth [10-12]. The multi band OFDM UWB proposal given by IEEE802.15.3a standard, the whole spectrum split into 14 number of sub bands having 528 MHz of bandwidth shown in fig. 1. All of these sub bands uses OFDM modulation for the transmission of the information. These 14 sub bands are combined in five groups named by group A, B, C, D and E. The 3 initial sub bands with spectrum of 1.8GHz (3.1GHz-4.9 GHz) are called mandatory mode or group A shown as in fig. [13-14]. As the MB-OFDM Signal is generated by Rectangular pulse signal, but its spectrum includes the side lobes, which may create interference in IPS. On the other hand a Gaussian waveform is a bell shaped function and is normally distributed with equal number of measurement with respect to its mean value (upper and lower of mean). Its spectrum does not contain any side lobes; hence this signal is immune to interference in the area of localization. It can also be used for clustering, that is a set of data points can be grouped into a cluster and it allows an efficient calculations in statistical analysis. So we simulate here both Rectangular pulse and Gaussian pulses to carry out the operation of localization in Indoor area system.

Proposed System Model for TOA (Time of Arrival) Estimation

The proposed system to investigate the suitability of these two different pulses is shown in Fig.2. Here, a UWB transmitter generates very short duration pulses that are passed inside indoor area channel. In the Receiver section the UWB receiver processes the transmitted signal along with noise. To remove noise at the receiver side, the average of the noisy signal is taken into consideration and it is passed through the correlation block, where the operation of correlation is performed between the received signal with that of the referenced signal. Now the output is passed through a peak detector, which determines the information about To A of the UWB signal for Localization in Indoor area system. The UWB simulation parameter values to study the suitability of the rectangular pulse and the Gaussian pulse are listed in Table-1. The simulation is done using MATLAB. Fig.3 represents the Gaussian pulse simulation. In Fig. 4, the convolution operation is done in between the UWB signal and that of the channel. After that the transmitted signal is added with noise as shown in Fig.5. Now the noisy signal is delayed as shown by Fig.6. In Fig.7, it represents the Averaging operation at the Receiver side. Finally the peak detection occur by the operation of correlation, the peak detection occurs at 600numbers of samples as shown in Fig.8, the 600 samples correspond to a ToA of 10ns. This results in a ranging of 3m. These results correspond to a channel type primarily of the CM2 (0 to

4mt with NLOS), the ranging information so obtained is used further to locate the coordinate of target unit in the area of localization.

Simulation Result for Rectangular Pulse Signal

Fig.9 represents the Rectangular pulse simulation. In Fig. 10, the convolution operation is performed between the rectangular signal and that of the channel. After that the transmitted signal is added with noise as shown in Fig.11. Now the noisy signal is delayed as shown by Fig.12. In Fig.13, it represents the Averaging operation at the Receiver side. Finally the peak detection occur by the operation of correlation, the peak detection occurs at 1000numbers of samples as shown in Fig.14, the 1000 samples correspond to a ToA of 16.66 ns. This results in a ranging of ranging 5m. which corresponds to a channel type of the CM3 (4 to 10mt with NLOS).

CONCLUSION AND FUTURE WORK

This paper analyzes the Gaussian signal and Rectangular signal for finding out the time information, which is required for estimating the Indoor area for UWB localization.From the different output results, it is come to an end that the simulated output for Gaussian pulse represents a smooth representation of distance estimation, but the range of area for experimentation is low. On the other hand the estimated distance for localization using Rectangular pulse increases, but its output representations signifies slightly complex delegation. Further, a Gaussian pulse is more suitable for a CM2 channel while CM3 channel type is better served by a rectangular pulse. The future work is to carry out the localization in indoor area system through these distance values by the application of machine learning techniques.

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Table 1: UWB Simulation Parameters

Simulation Parameter for UWB	Value
Light Speed	3×10^{8} m/s
Shape of pulse	Gaussian, Rectangular
SNR	30dB
Sample rate	60GHz
Pulse width	0.5ns
Number of samples	1000
Variance	0.2

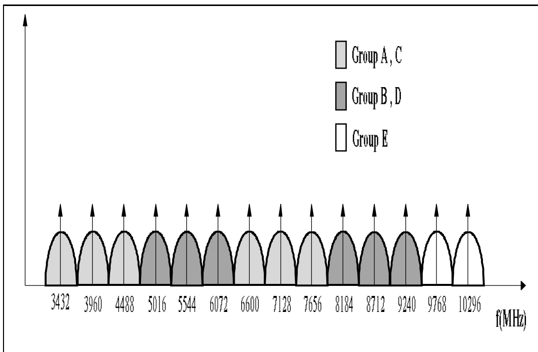

Fig. 1 Band planning structure for the MB OFDM system

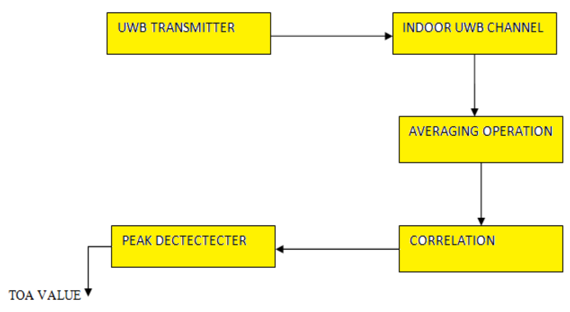

Fig.2 Block diagram for UWB Simulation system[15]

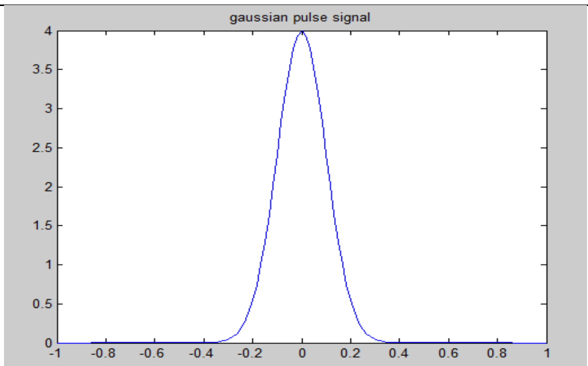

Fig.3 Gaussian Pulse Signal

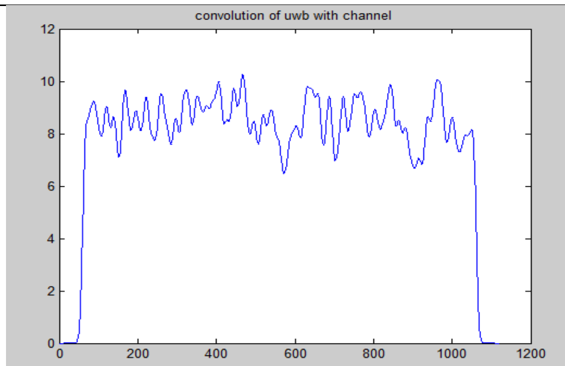

Fig. 4 Convolution of UWB with Channel

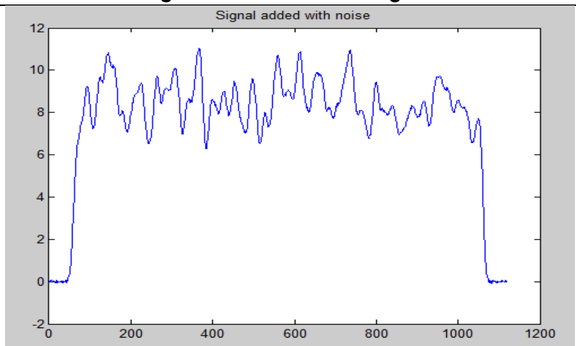

Fig.5 Signal added with Noise

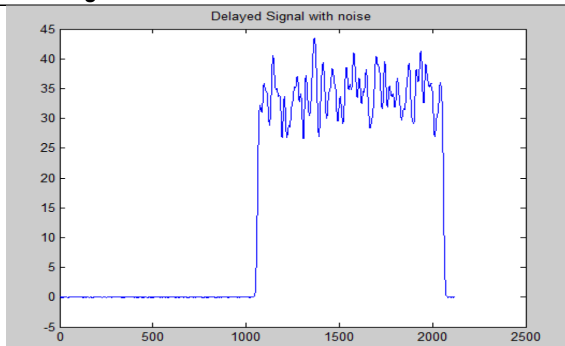

Fig.6 Delayed signal with Noise

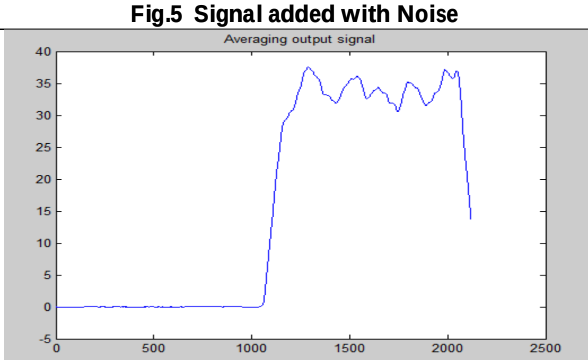

Fig.7 Averaging output Signal

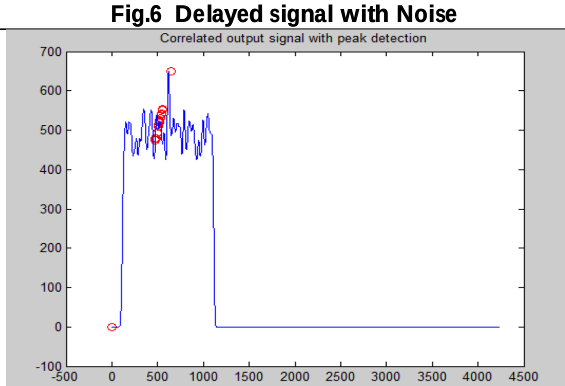

Fig.8 Corelated output signal with peak detection

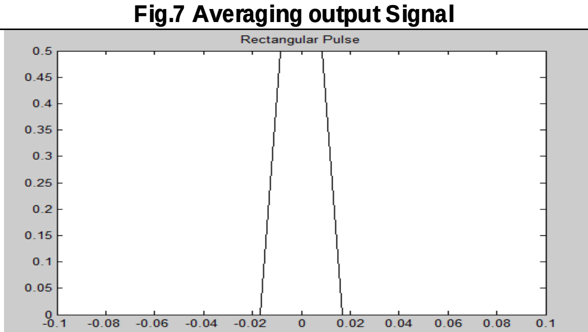

Fig.9 Rectangular pulse signal

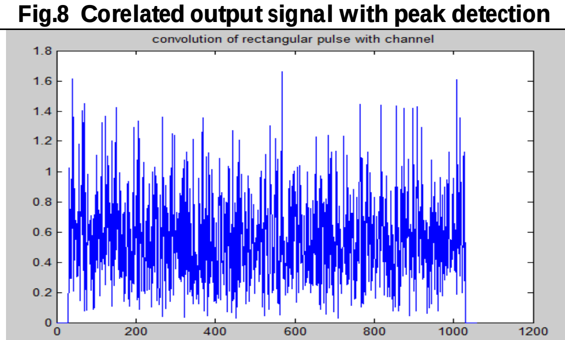

Fig.10 Convolution of rectangular pulse with channel

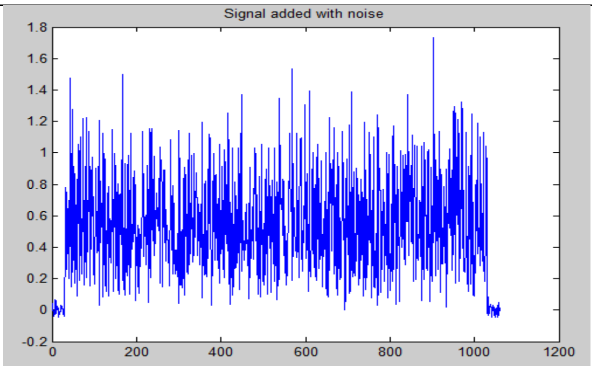

Fig.11 Signal added with Noise

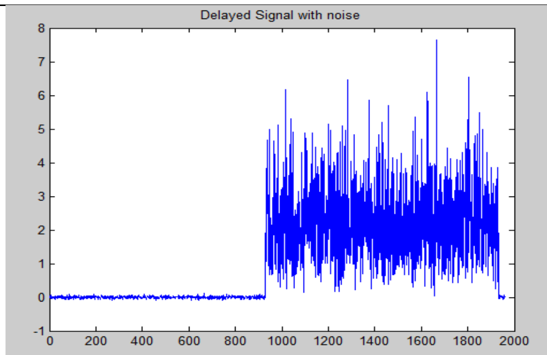

Fig.12 Delayed signal with Noise

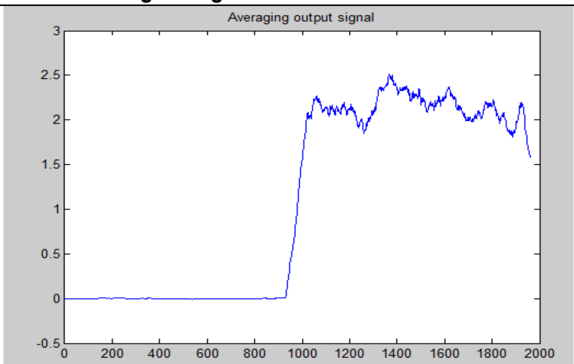

Fig. 13 Averaging output Signal

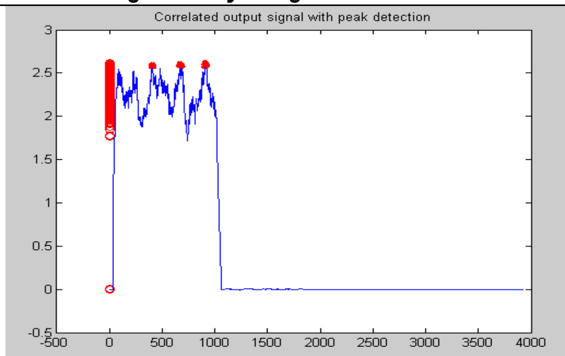

Fig. 14 Corelated O/P for Rectangular signal