Design Low Power Detection QPSK-Transceiver for UWB Techniques

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Abstract This paper presents the implementation and investigation of the quarter phase shift keying low power detection. The receiver is designed and modeled using Matlab. It was tested for different values of SNR with a constant input signal power of 100 mW. The FFT based receiver performance is measured theoretically by transmitting 1000 information symbols from the transmitter end with 7 dB improvement at Bit Error Rate BER of 10^-4. Multi Modulation Techniques Recommended and not Recommended are simulated in this research. In this research the modulation method was selected on the basis of reducing rates of the interference in the UWB communication techniques and the essential modulation should have several types of spectrum random distribution methods to reduce the level of the interference on account of the impulse train that transmitted.

Keywords: UWB, QPSK, Detection, Modulation Techniques

1. Introduction
One of a very important goal in communication wireless systems is to reduce the consumption of power, and this mean that a reduction of power can to achieve when the way to reduce a complexity in the receiver on another side may be decrease the performance on the communication system. One of the most difficult problems facing telecom engineers and mobile design engineers today is the design of these low-power devices to make the performance of these devices better but we face the problem of the strong relationship between the complexity of the system and the consumption of these devices for energy. One of the most effective solutions for designing modern communications systems in low power is the use of Digital CMOS technique that you can remember \( P = C V^2 f \), where \( C \) represented the average load of a capacitance which is being switched, \( V \) represents the supplied voltage, and where \( f \) is represented the frequency of a switching that events [1].

Recently, some interesting approaches, an overview of wireless receiver architectures, a demonstrated study the characteristics of several typical structures, also to analyze the advantages, disadvantage of several classical and modern structures and summaries their improvements. One another hand interesting approach is a low power QPSK receiver introduced. We use here for the receiver 16-point FFT but a same scheme implemented a low power of detected with the signal. In order to solve this problem in reducing the energy consumed by the system and thus to make the level of complexity at the lowest level in this case were adopted sub-samples of radio frequency and then processed data information of one-bit [2]. Reducing the supply voltage to the lowest possible level in
the system provides a major motivation through the quadratic capacity dependence of this supply voltage. Thus, any expansion in the range of voltage will provide significant improvements in the amount of energy consumption. The use of low-energy technology FFT architectural is the ideal solution to effectively improve the system’s performance. This architectural design of FFT technology relies on the structure of a entirely time multiplexed and a fully space-parallelized architecture. Throughput is defined as the reciprocal of the time deference between successive outputs. It depends on number of operations, amount of data to process, and time available to process. One of the main factors useful for the FFT technique is to use a butterfly like radix-4 butterfly[3]. An important feature in such a case is the method of computed the butterfly without a twiddle factor multiplication. In order to achieve this philosophy, the total number of complex twiddle factor multiplications that must use a radix-4 FFT to be equal a half the number of algorithm radix-2 FFT required as shown in figure 1. As a comparison between the two images in figure 1 and figure 2 it appears that the number of multiples for Radix-4 has decreased and which helps to decrease is the linear decomposition of the matrix with additional additions [4].

![Figure 1. Block diagram of Radix-2 butterflies](image)

2. Radix-4 algorithms more restrictive
The radix-4 butterfly is the building block for power-of-four FFT algorithms, though the radix-4 algorithms are more restrictive on available input sequences, they require fewer twiddle-factor multiplications. A simple DFT based detection shame is used to demodulate the PSK signal. both power and throughput are worked to be able to arrive at a more parallel and solution and accurate at the same time FFT can be reorganized in an arithmetic manner so that the required amount of the computation can be reduced as:

\[ N = \text{degree} (p) \times \text{degree} (m) \]  

(1)

The number of times that each of the stages of the butterflies to generate N data samples is the degree of temporal multiplexing degree (m), a supply effort which reduced and to reduce the supply effort in the can be achieved by using radix \( r > 2 \). In this way then for each time it can relaxed the requirements of throughput through of processing a more of data samples. Figure 2 show the relationship between the degree of multiplexing and parallelism and the degree is an inverse relationship. The reduction of degree parallelism increases the degree of multiplexing and vice versa. Thus, it is possible to control the number of butterflies. The total number of butterflies decreases when an increase in the number of \( r \) rad. For example, if radix \( r = 4 \), then degree \( p = 4 \), will also degree \( m = N/4 \).
3. Multi Modulation Techniques Recommended and not Recommended

UWB technology is a tractive wireless communication system because of several features, the common feature is the ability to rearrange and exploitation the currently existed spectrum. This feature came relying on property of low PSD which it UWB impulse nature, this in turn led to the emergence of spectrums of contiguous [5]. Since it is known that the allowable frequencies for UWB is between (3.1-10.6) GHz to communication techniques a contiguous could happen between two bands of frequencies the UWB and narrowband techniques and influence be interchanged among them [6]. Information can be modulated using a series of impulse better than using the same impulse only and accordingly to that more information will be transmitted [7]. The time based and the shape based methods are the main types of UWB modulation as shown in the figure 3.

![Effective Modulation Techniques For UWB Communication](image)

### 3.1. PPM (Pulse Position Modulation)

PPM depends on the time in the modulation mechanism and perform that by the transformation the position of the impulse to the fixed time index called $\delta$ or modulation index when need to transmit bit (1) and stay in his position if transmitted bit (0). The integration between time hopping technique and PPM method would play a major role in the elimination of the multiuser interference issue [8].

### 3.2. BPM (Bi-phase modulation)

BPM depends on the shape in the modulation mechanism and perform that by making an impulse together with reverse phase as shown in figure 4. The most important causes to use BPM relative to PPM is 3dB power adequacy [9]. BPM is an antipodal technique relative to PPM that is an orthogonal
technique. Because the PPM permanently delay and squandering the time, the BPM enables to transmit double the information compare to the PPM [10].

3.3. OOK (On-off Keying)
OOK is also depends on the shape in the modulation mechanism and perform that by absence or existence the impulse (0 bit, 1bit) respectively [11].

3.4. PAM (Pulse amplitude modulation)
PAM is also depends on the shape in the modulation mechanism and perform that by varying the amplitude (capacity) of impulse. PAM is not suitable for UWB communication technique, and consume a high power when deals with peak amplitude[12].

![Modulation techniques impulses](image)

**Figure 4.** Modulation techniques impulses

4. **Results and Discussion**
Aybrid bi-phase position modulation (bppm), We can combine the two methods (PPM and BPM) and applied on UWB impulse (just one signal) in order to get (M ary) modulation technique as shown in figure 5. From previous studies and analyzes showed that the BPM and Auto-Correlation technique have close relationships with a lot of properties (plainness, do not need to channel assessment and little power for communication) and this can also take advantage of it to reduce the interference between multiuser in UWB system [5].

The combination of the above techniques leads to reduce the comb (lines of the spectrum) and thus lead to decrease or minimize interference between UWB and the other technology as a result of reducing the width of the spectrum (which increases the likelihood of interference Between UWB and other technology or between UWB themselves in peak condition)
Figure 5. Hybrid bi-phase position modulation

A digital modulation here to describe a diagram of the phasor representation as shown as in the figure 6.

Figure 6. Phasor representation of digital modulation
The constellation diagram of figure 7 (c) consists of 8 equally spaced points on a circle, the bit rate is 4800 bps, a baud would be 1600 baud for each signal element carries 3 bits/signal, also the baud will be 500 baud for each signal element carries 6 bits when the signal is 3000 bps.

Figure 8 shows the performance of direct sequence DS-QPSK with its parameters for each, over Rayleigh and AWAGN channel. It is clear that there is significant gain 2dB is achieved at $10^{-4}$.

![Figure 7. Comparison multi recommended modulation](image)

![Figure 8. Performance over multi-channel](image)
Figure 9 illustrate the performance of implementation over BPSK compared to DS-QPSK the Bit error rate decreases as the SNR increases, it is clear after 7 dB the SNR increases to 14 dB at $10^{-4}$

![Figure 9. Performance of implementation over BPSK](image)

5. Conclusion
In this study, we conclude that there are two main factors that affect the total complexity of the FFT. The first factor is the exact choice of Radix r. The second factor is the degree of parallelization. The reduction of the parallelization will reduce the total circuit capacity, which reduces the size of the circuit, but increases the critical delay requirements of the system. In addition, it will increase the required supply voltage of the system and vice versa. Increases in the degree of parallelization (P) will increase the total capacity of the circuit as well as increase the size of the system and at the same time reduce the requirements of critical delay and this means reducing the effort required to supply. We concluded that in research simulation that the DS-QPSK is our selection of multiple modulation recommended, achieving of system performance is improved over BPSK. Mostly the code, space and time division methods integrated with modulation techniques to reduce the impact of the interference in the UWB system.

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