Design of ED-PWM system an UWB wireless communication system

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ABSTRACT
Ultra-wideband wireless communications technology has many merits, including an extremely simple radio that inherently leads to low-cost design, large processing gain for robust operations in presence of narrowband interference, covert operations, and fine time resolution for accurate position sensing. However, there are a number of challenges in UWB receiver design, such as capturing multipath energy, inter-symbol interference especially in a non-line-of-sight environment, and the necessity for high-sampling-rate analog-to-digital converters. In this article we provide a comprehensive review of UWB multiple access and modulation schemes, and their comparison with narrowband radios. We also outline issues with UWB signal reception and detection, and explore various suboptimal low-complexity receiving schemes.

Keyword: *Keywords-Ultra-wideband (UWB); pulse width modulation (PWM); pulse position modulation (PPM); bit error rate (BER); additive white Gaussian noise channel (AWGN).*

1. INTRODUCTION
FCC Defined a signal is an UWB if the bandwidth of the signal is

$$B \geq 500\text{MHz}.$$

Ultra Wideband Impulse Radio (IR) has attracted much interest for indoor high rate communications due to its significant characteristics.The fundamental characteristic of UWB is the extremely large bandwidth requirement since very narrow pulses with appropriate shape and sub-nanosecond duration, referred to as monocycles, are being used by the transmitted signal. It also exhibits robust multiple-access (MAC) performance with little interference to other communication systems sharing the same bandwidth due to its very low power spectral density (PSD).

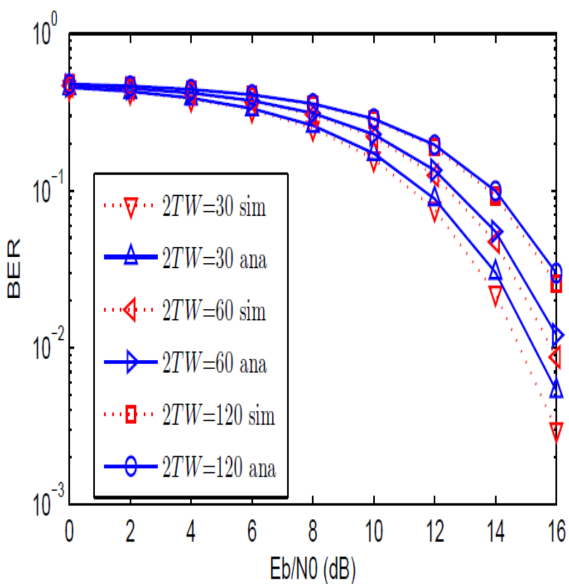
Ultra Wideband radio would rather change some pulse parameter such as pulse position, pulse amplitude and so on to implement modulation than adopt the sine carrier for information transmission. There are various modulation scheme investigated in many papers. Pulse position modulation (PPM) and pulse amplitude modulation (PAM) are popular in IR-UWB schemes due to their feasibility and their performance are extensively developed in. Furthermore a composite modulation scheme named pulse position amplitude modulation (PPAM) combines PPM andPAM constellations to provide a better trade-off between systemperformance and complexity. The performance of UWB transmission with RAKE reception and PPM modulation is given in. The channel capacity of PPM is determined for a time-hopping multiple-access UWB communication system and the error probability and performance bounds are derived for a multiuser environment in. Reference presents two novel hybrid modulation schemes for Ultra-Wideband (UWB) communication systems using Time-Hopping Spread Spectrum (TH-SS) techniques. These schemes are namely: Biphase N-ary PPM and Biphase M-ary PAM. In the BiphaseN-ary PPM, a combination of PPM and Binary Phase Shift keying (BPSK) provides better system performance with low computational complexity, while the Biphase M-ary PAM combines the PAM and BPSK to give enhanced system performance and the same complexity. This paper presents a new modulation scheme - pulse width modulation (PWM) that employs pulses with same amplitude and different width to carry different information, unlike PPM and PAM. The remainder of the paper is organized as follows. Section II describes signal format of binary TH-PWM and binary TH-PPM systems. The BER performance of TH-PWM system is derived under no inter-frame interference (IFI) and no inter-pulse interference (IPI) assumption in section III. The theoretical and computer simulation results are presented in section IV. Finally, section V concludes the paperUWB is widely used in LPI, LPD system and in other commercial application as like unmanned Arial Vehicle and Unmanned Ground Vehicles etc.

2. BER PERFORMANCE OF PWM

The 'Bit Error Rate (BER)' is the no. of 'bit errors' divided by the total no of transferred bits during a time interval. BER is unit less measurement often expressed in percentage(%) the total BER of PWM in AWGN channels is,

$$P_e = Q\left(\frac{\frac{4}{3}\frac{E_b}{N_0}}{\sqrt{2TW + \frac{8}{3}\frac{E_b}{N_0}} + \sqrt{2TW + \frac{4}{3}\frac{E_b}{N_0}}}\right)$$

Where T is the integration time and W is the bandwidth of the filtered signal.



3. ENERGY DETECTION RECEIVER

Fig.shows the structure of energy detection (ED) receiver, where s(t) denotes the signal arriving at the receiver, n(t) is additive white Gaussian noise (AWGN) and r(t) = s(t) + n(t) denotes the composition of signal and noise. The filter is designed to capture as much signal energy as possible and suppress out-of-band noise simultaneously**.**

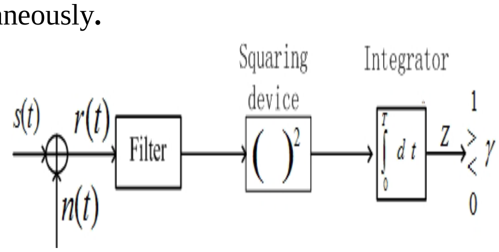


Fig. Energy detection receiver

4. MODULATION TECHNIQUE

There are two receiver methods of UWB systems: coherent and non-coherent methods. The coherent receiver method includes rake receiver, and the non-coherent methods include energy detection, transmitted-reference and differential detection.

In this paper presents a new modulation scheme- energy detection pulse width modulation (ED-PWM) for UWB communication systems and describes the signal model modulated by this modulation scheme.

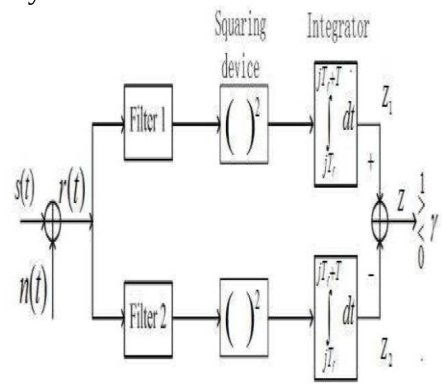


Fig. ED-PWM receiver

The signal arriving at the receiver is denoted by s(t), the AWGN is denoted by n(t), and the sum of s(t) and n(t) is denoted by r(t). The integration interval $T \leq T_f$. The decision statistic is given by Z = Z1−Z2, where Z1 and Z2 are the outputs of branch 1 and 2,respectively. Finally, Z is compared with threshold γ to determine the transmittedbit. If Z ≥ γ, the transmitted bit is 1, otherwise it is 0.

4.1 Advantage of ED-PWM receiver

In multipath channels, PPM suffers from cross-modulation interference if the integration interval is shorter than maximum channel spread. PWM dose not suffer from cross-modulation interference. This makes PWM a better scheme than PPM for high data rate communication when the integration interval is shorter than the maximum channel spread. Also when synchronization errors occur, PWM is more robust and achieves better BERperformance than PPM. Themain advantage of ED- PWM Is it uses lower order Gaussian pulse generator.

5. CONCLUSION

This paper presents a new modulation scheme-PWM and describes the ED-PWM signal model. This system gives the better BER performance in presence of CMI and synchronization errors. Hence this system robust signals bandwidth. When the GFSK is compared to PWM it exhibits better BER performance in AWGN channels, multipath channels, andin presence of synchronization errors. However, PWM systems uses lower order Gaussian pulse generator than GFSK systems, so the pulse generator in PWM is easier to implement than that of GSFK.

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