Performance Improvement of Ultra Wideband Multiple Access Modulation System using a new Optimal Pulse Shape

Vikas Goyal[1], B.S. Dhaliwal[2]

[1] Department of Electronics and Communication Engineering, Guru Kashi University, Talwandi Sabo, INDIA.
[2] Department of Electronics and Communication Engineering, Guru Kashi University, Talwandi Sabo, INDIA.

*corresponding author, E-mail: vikas312002@yahoo.com

Abstract

Ultra-wideband (UWB) uses very low energy levels to transfer data at very high data rate and bandwidth. An optimal and correct choice of transmission pulse shape is an important criterion in this technology. In this paper, we will present an approach for the generation of an optimal pulse shape with the optimal generation of pulse shape values that can provide effective results when transmitted using multiple access modulation technique over a multipath channel and received by a RAKE type receiver. The bit error analysis of constructed model is also given using Ideal Rake, selective RAKE, and partial RAKE receiver configurations.

Keywords: UWB, PPM, PAM, PAM-TH, RAKE, Multipath.

1. Introduction

Ultra-wideband (UWB) technology is referred to as baseband, carrier-free or impulse technology, used to provide very high data rates at very low power levels for short and medium range communication systems. In 1998, the Federal Communications Commission (FCC) [1] started the transmissions norms. UWB systems with central frequency (f_C) greater than 2.5 GHz requires a bandwidth of at least five hundred MHz, while UWB systems with the central frequency less than 2.5 GHz should have the fractional bandwidth (Bandwidth/central frequency) of at least 0.2 [2][3]. Ultra-wideband communication technology is very useful for communication and remote sensing applications. Due its high bandwidth, it is used for short to medium range wireless applications. The spectrum allocation to ultra wideband systems has been shown in fig.1. For the generation of UWB signals a research paper [4] explained that Impulse radio can be used for ultra wideband transmission using a Gaussian monocycle pulse. Another research paper [5] explained different pulse shapes that can be used for UWB communication systems. Ultra-wideband pulse design method has been proposed that made use of a linear pulse combination waveform of the sub-band signals [11]. A linearly combining two monocycles using different pulse shapes is described in [12] to satisfy the radiated power limits of ultra wideband transmission. A combination of Gaussian derivatives over definite sub bands to increase the power spectrum utilization is described by taking the pulse shaping factors and the number of derivatives by trial and error method for selecting the pulse shaping factors for different Gaussian derivatives to match the emission mask was presented in the article [14]. In Research paper [18], UWB pulses and their respective power spectral efficiency was generated by combining the multiple monocycle pulses of first, second, third and fifth Gaussian derivatives with their inverse polarities to meet the emission mask criteria. Another article [19] presented the pulse design technique based on linear combination of Gaussian doublet pulses and found that their proposed pulse, showed better spectral power efficiency as compared to other conventional pulse shapes. A new UWB pulse shaping method was also presented in [20] that divided the entire spectrum of UWB into different regions, and in each region the Gaussian pulse and its derivatives were combined, using least square error combination technique with same pulse shaping values. IEEE 802.15.3a Channel Model described in [7] [16] for Ultra wideband Indoor Communication. Research paper [8] illustrates direct sequence impulse UWB radio modulation systems. Article [9] [22] presented the applications of the ultra wideband communication systems. Article [10] [15] [23] presented the RAKE receiver with Maximal Ratio Combining for ultra wideband communication systems.

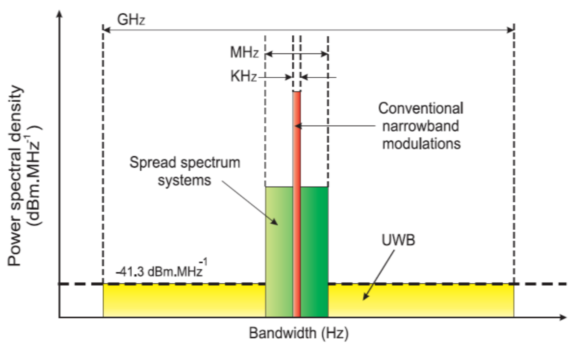

Fig.1. Spectrum allocation of UWB

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