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Millimeter Wave generation using MB-OFDM-UWB

K.Pavithra, Byna anuroop and G.Vijayalakshmy

***Abstract*—In this present technology, scientists have taken the maximum effort of research on UWB signals, which is useful in the field of the sensor networks and wireless data network access. UWB provides high speed data communication without compromising frequency band. The major limitation in the UWB systems had to encounter with interferences with narrow frequency band levels. Multiband orthogonal frequency division multiplexing ultra wideband (MB-OFDM UWB) generates a 60 GHz signal. In next generation wireless technologies, they are making use of millimeter waves (unlicensed band) for transmitting instead of microwave in order to avoid interference and absorption or loss of signal. In this paper MB-OFDM based UWB for millimeter wave propagation over optical fiber transmission system is proposed and analyzed using MATLAB.**

***Index Terms*—MB-OFDM, UWB, Millimeter, Wireless**

I. INTRODUCTION

MB-OFDM Ultra Wide Band Signal is used for the modulation of a dual-arm Mach-Zender modulator which is external to generate an optical signal side band signal with an unmodulated free running continuous wave laser is discussed in [1]. An UWB system is defined as the systems have minimum bandwidth of 500 MHz and its frequency should be greater than 20% of its center frequency [2].

They are having higher propagation losses in the mm-wave frequency band than at the lower frequency bands. Currently many applications aimed to precision locating and tracking applications [3]. However, these schemes are deprived by the need for signal control techniques or high-frequency electronic optical devices [4]. An ultra multi band is a mature technology with efficient hardware and software technology [5].

The transmission of ultra wideband (UWB) radio signals over optical fibers by mixing the UWB radio frequency signals of several Giga hertz on the optical continuous wave carrier [6]. The phase noise of the carrier generated by the combination of the two uncorrelated optical sources on a photo detector significantly reduces the detection performance of the transmission system. Phase noise may noticeable itself in the lengthening of the other Spectral line width. In the absence of phase noise, the photo-detected electrical signal at an intermediate frequency (IF) can be detected by removing a signal from it, followed by coherent Demodulation. However, in the presence of phase noise, a Carrier retrieval circuit might have difficulties in tracking variations in the phase, resulting in deprivation of the detection performance. Instead of these phase-noise effects can be avoided at baseband by utilizing a self-homodyning receiver or an envelope detector with sufficient IF bandwidth [7]. The proposed system develops square-law envelope detection at the customer unit to down-convert the mm-wave wireless signal. Envelope detection is chosen over self-homodyning because it is cost efficient and has been shown to afford better sensitivity [8]. An Ultra Wideband (UWB) is an area of sensor networks and wireless broadband data access. Analog space-time coding for Multi-antenna ultra wide band Transmissions is discussed in [9]. Ultra wideband is a radio technology which may be used at a energy level which is low for short distance and high bandwidth communications. An ultra wide band is a technology for transmitting information spread over a large band width. In theory and other circumstance, be able to share spectrum with other user [10].

UWB has the potential to address this problem and revolutionize radio communications, radar & positioning. It allows co-existence with the already licensed operators in the lower band of the radio spectrum & can also be used in the higher band as well. UWB radio signals, sometimes referred to as baseband, impulse or carrier less radio, employ the generation & transmission of ultra short impulses of radio energy whose characteristic spectrum signature extends across a very wide range of frequencies. They involve bandwidths in excess of 1 GHz [11].

There is two types of UWB first one is MB-OFDM (Multiband orthogonal frequency division multiplexing) UWB another one is IR (impulse radio) UWB. Impulse radio (IR) UWB communication is free of noise and carrier signal. It is used for the communication between the transmitter and receiver end while outdated transmission systems transmit information by changing the power, frequency, and phase of a sinusoidal wave in a modulation process [12].

The selection of the impulse signal type for IR UWB communication system is essential since it determines the system performance. Gaussian wave pulses are the most

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K. Pavithra, Electronics and Communication Engineering, Pondicherry University/Perunthalaivar Kamarajar Institute of Engineering and Technology, Pondicherry, India, (e-mail: pavijasmine2@gmail.com).
Byna Anuroop, Electronics and Communication Engineering, Pondicherry University/ Perunthalaivar Kamarajar Institute of Engineering and Technology, Pondicherry, India, (e-mail: byna157anuroop@gmail.com).
G. Vijayalakshmy, Electronics and Communication Engineering, Pondicherry University / Perunthalaivar Kamarajar Institute of Engineering and Technology, Pondicherry, India, (e-mail: vijipec_03@yahoo.co.in).

widely used waveforms due to their simplicity and availability. MB-OFDM UWB signals allow the transmission up to 60 GHz through optical fiber link using central station and base station configuration. It has advantages such as high data rate, speed and low cost. It has been using for the radar system because UMB signals having large bandwidth with short pulses other than communication applications [13]. The UMB devices can be used for imaging, locating remote areas and radar which was used for the military purposes. Ultra multiband shows higher propagation losses in the millimeter-wave frequency band than lower frequency bands [14]. However these possible arrangements are deprived by the need for controlling signals or electronic and optical devices which support high frequencies [15].

The rest of the paper is organized as follows. The section II discuss about proposed novel system model for MB-OFDM based UWB. In Section III Performance analysis of the propose work is discussed. Section IV concludes the paper with future work.

II. Proposed System Model

A. Motivation and the proposed system

UWB along with MB-OFDM system will provide less noise over radio over fiber system. The main idea is to modulate the pulse train to resist interference and to cover long distance. Impulse radio (IR) UWB communication technique is carrier free and uses for communication between transmitter and receivers, radio frequency which is narrower and generates pulses from the UWB generator, while present transmission model transmit information by varying the frequency, Power and phase of a Continuous sinusoidal wave in a transmission process.

The choosing of the impulse signal for IRUWB communication system is essential since it determines the overall performance. Gaussian pulses are used waveforms due to their simplicity and achievability. MB-OFDM UWB signals enable the transmission up to 60 GHz through optical fiber link using base station and central station configuration for wireless communication. Here in the proposed model base station and central station configuration along with corresponding output is shown.

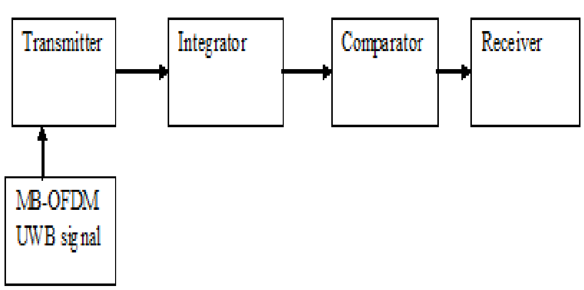

Figure 1 Proposed system model to reduce noise

Figure 1 shows block diagram of the proposed remote heterodyne system. The proposed model consists of Transmitter part, Correlated receiver, Comparator, Receiver. Here In the transmitter paper Laser diode is used to provide long distance communication with higher efficiency. Here MB-OFDM UWB signal is transmitted via optical fiber system. The output of the transmitter part is sent to Correlated receiver (Integrator) which will act as LPF (Low Pass Filter) to filter the noise.

The filtered output is sent to the comparator block to compare with threshold. Comparator sends the output to the receiver part. Here the receiver used is photo detector for more sensitivity. Hence the proposed model is used for both short and long distance communications with high data rate in both Base station and mobile station. The efficiency is increased with less complexity and cost.

For MB-OFDM UWB three bands are transmitted and modulated using BPSK and have a bandwidth of 800 MHz, centered at frequencies 2.432, 4.96 and 6.488 GHz respectively. With these simulation parameters, the OFDM symbol duration for each band is 312.5 ns. Consequently, the bit rate of each band is 640 Mb/s, providing an overall data rate of 1.92 Gb/s for the three bands.

III. Performance Analysis

In the performance analysis Modulated pulse train, Un-modulated pulse train, LPF (Integrator) output, comparator output of the proposed model is analyzed. Here MB-OFDM is used as transmitted Base band signal

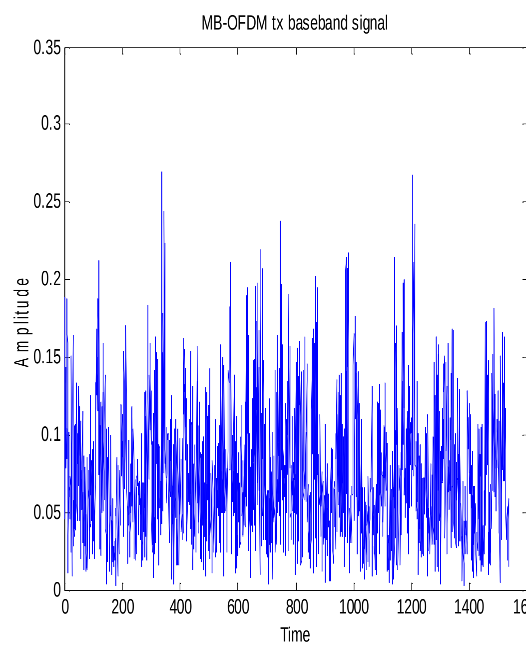

Figure 2 MB-OFDM Transmitted Baseband signal

Figure 2 shows the MB-OFDM transmitted Baseband signal for the proposed architecture. Multiband OFDM is having lot of advantages when compared to single band OFDM technology. It is used to provide Gigahertz frequencies. This is transmitted via radio over fiber system.

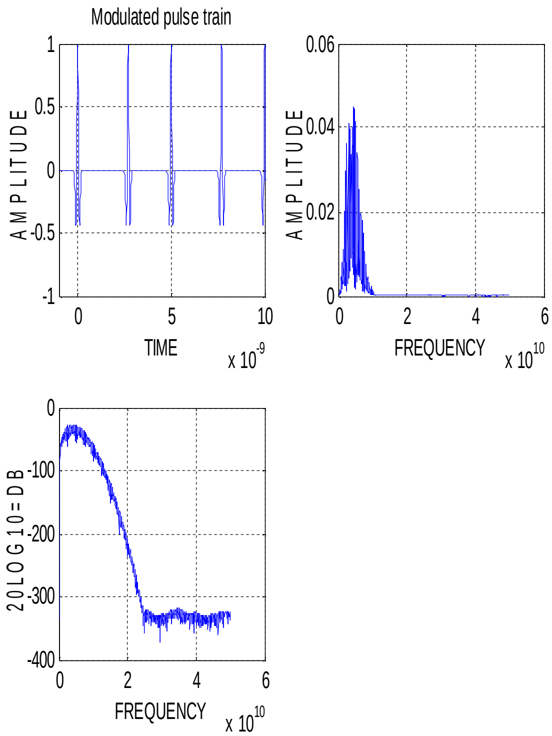

Figure 3 Modulated Pulse train

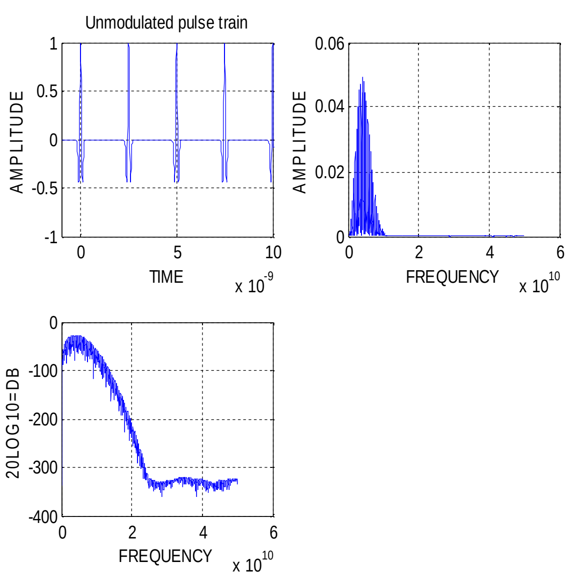

Figure 4 Un-modulated Pulse train

Figure 3 shows Modulated Pulse train and its corresponding frequency plot and gain plot is shown. The output shows generation of nearly 60 GHz frequency range with respect to gain plot. Hence proposed architecture outperforms very well. Figure 4 shows Un-modulated pulse train and its corresponding frequency plot and gain plot.When the modulating signal is positive, the width of the un-modulated carrier increases in proportion, and when the modulating signal is negative, the width of the un-modulated carrier decreases in proportion.

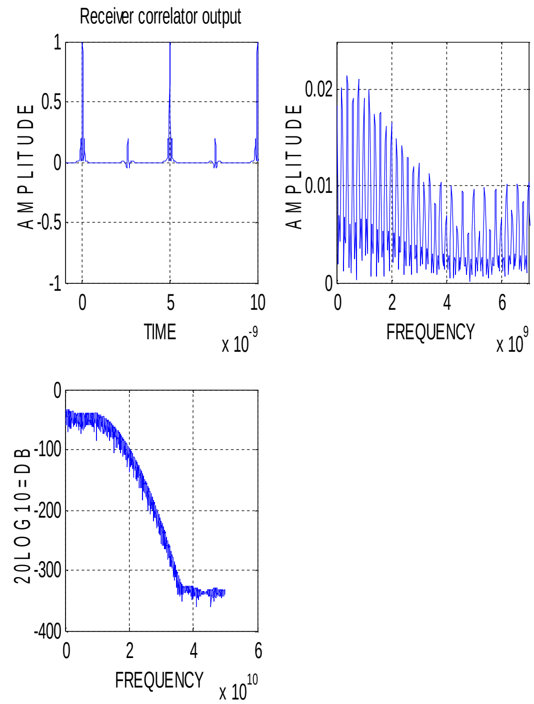

Figure 5 Receiver Correlated Output

One single UWB pulse does not have any valuable information. By means of modulation, digital information should be added to analog pulse. In MB-OFDM-UWB, there are several methods of modulation. They are coming under time based techniques and shape based techniques. Already in the literature Pulse Position modulation is there where each pulse is delayed or sent in advance at regular time scale.

M-ary system can be used for producing specific time delays. Another method is to invert the pulse to create pulse with opposite phase called as Bi-Phase Modulation. Here orthogonal pulse modulation technique is used in proposed system model. Here special pulse shapes are generated which is orthogonal to each other.

Here orthogonal functions are used to reduce the interference of the symbols.

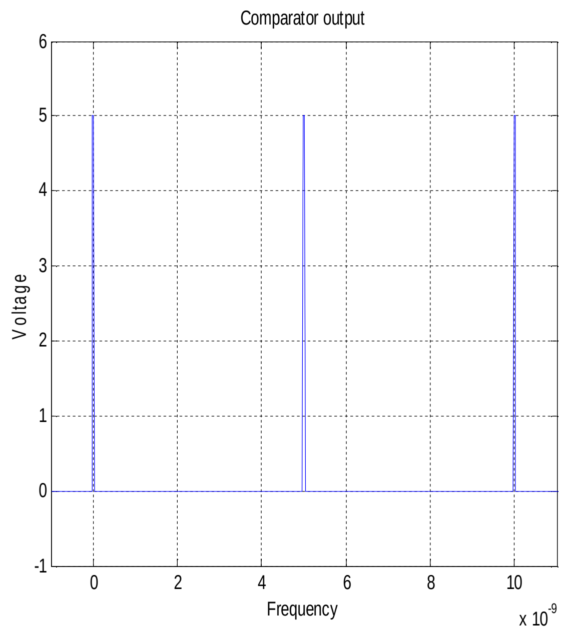

Figure 6 Comparator Output

Figure 5 shows Low pass filter output and corresponding frequency plot and gain plot. Here after noise removal frequency range is increased when compared to figure 3 and figure 4. The correlation receiver is nothing but matched filtering receiver, instead of a simple switching part. The multiplication is followed by integration in Correlation.

Figure 6 shows Comparator output for the proposed system. The comparator output shows the centered frequency at 0.5 GHz, 5 GHz and 10 GHz for corresponding voltage of 5V. The comparator is the last stage and it consists of differential amplifier which will act as a limiting stage and buffering inverter.

In the positive input port the envelope signal is applied and compared at the negative input for controllable reference threshold voltage. Moreover, because the overall gain of two stage amplification part is very higher, the digital pulse signal with some duration time is generated at the output point, whenever the voltage of input pulse signal is high enough to ignite the comparator output. The threshold voltage control is used to tune the duration time of output digital pulse.

IV. Conclusion

The MB-OFDM UWB offers new applications and used in wireless technology development due to its wide bandwidth, high data rate and consumption of low power. MB based MB-OFDM provides multipath environment in UWB signals. Using the proposed system, multiple wide-bands BPSK OFDM channels have been successfully transmitted over 50 km without any chromatic dispersion compensation and a further 6 meters wireless distance. The proposed system outperforms well in data rate, frequency range, coverage and long distance communication using laser and photo diode.

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K. Pavithra, is currently doing her B. Tech degree in the department of Electronics and Communication Engineering in Perunthalaivar Kamarajar Institute of Engineering and Technology.

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Byna Anuroop, is currently doing his B. Tech degree in the department of Electronics and Communication Engineering in Perunthalaivar Kamarajar Institute of Engineering and Technology.

G. Vijayalakshmy, Assistant Professor in department of Electronics and Communication Engineering in Perunthalaivar Kamarajar Institute of Engineering and Technology. She had completed her B. Tech and M.Tech from Pondicherry Engineering College in the year of 2005 and 2009. She is currently doing her Ph. D in the area of Wireless communications in Pondicherry Engineering College. She had published 12 international journals in reputed journals, 15 international conferences and 3 national conferences.