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SIMULATED RESULTS OF FOUR CHANNEL BPSK DEMODULATOR USING COSTAS LOOP FOR MOBILE SATELLITE SERVICES

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ABSTRACT

This paper present demodulation process of multi carrier, which simulation result analyzed in MATLAB. Carrier recovery, symbol detection technique has been analyzed in MATLAB. Here RRC filter used for pulse shaping data, Costas loop for carrier recovery finally BER test result of demodulated signal are given.

Keywords: RRC filter,baseband signal,costas loop.

I. INTRODUCTION

With the popular demand of mobile satellite services like voice calls, short message services, video calls through satellite communications for terrestrial network multicarrier demodulator is very effective technique for receiving data instead of single carrier demodulator. This is especially true when the locations are dispersed over remote regions, and barely connectable via a terrestrial network infrastructure. In this case, satellite communications are an effective way to provide private or secure data networks. Satellite communications is becoming a viable means of providing a wide range of communications applications for both the commercial and military sectors. The most remote places on earth can have communications via satellite. the infrastructure, bandwidth, and availability of communications is important for satellite communication multicarrier demodulator is solution of the space requirements instead of using single carrier technique so in order to need, space requirement for terrestrial network this project will be carried out. Multicarrier demodulator is very effective technique instead of single carrier demodulator. Multicarrier demodulator is beneficial for space requirement with using one four-channel demodulator instead of four different single carrier demodulators. using one multicarrier demodulator we can be recover more data which carried by different carrier frequencies. This will be design on software based so it also reduces complexity problems. In this paper simulation of single carrier demodulation has been reported followed by multicarrier demodulation here costas loop have been used for carrier recovery

II. METHODOLOGY

Modulation is the process by which some characteristic of a carrier is varied in accordance with a modulating wave (signal) [1]. At the receiver end, demodulation must be accomplished to recognize the signals. The process of deciding which symbol was transmitted is referred to as a detection process. Typically, the receiver generates a signal that is phase-locked to the carrier. Carrier recovery is must important for demodulation. On the basis of analyzing the carrier recovery and symbol decoding algorithm simulate it by MATLAB is put forward.

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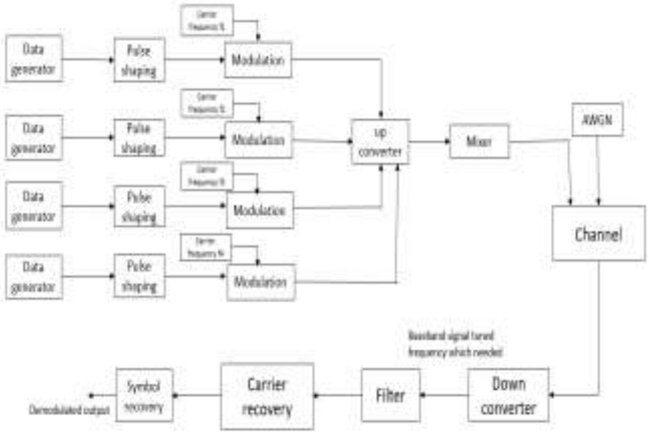

Fig.1 Block diagram of multicarrier demodulator

Block diagram of multicarrier demodulator as shown in fig.1 first of all data was generated which is random data which is passed through root raised cosine filter for pulse shaping binary data than modulation will be carried out after that noise will be added after modulation, then demodulation process comes in that down conversion, carrier recovery and symbol decoding is important parameters. At first for single carrier simulation process analyzed than same process will be used for multicarrier demodulation

III. SIMULATION RESULTS

Root raised cosine filter:

The Root Raised Cosine digital filter is a widely used pulse-shaping FIR filter in digital baseband communication systems. The design parameters of the filter implementation are strongly bound to the overall performance of the communication system rrc filter is cancel out harmonics of the binary data and shaping pulses which used to modulation here simulation result of pulse shaping using rrc filter shown in fig.2 which simulated in MATLAB. For simulation rrc filter roll of factor 0.25, samples per symbol is 4 have been used

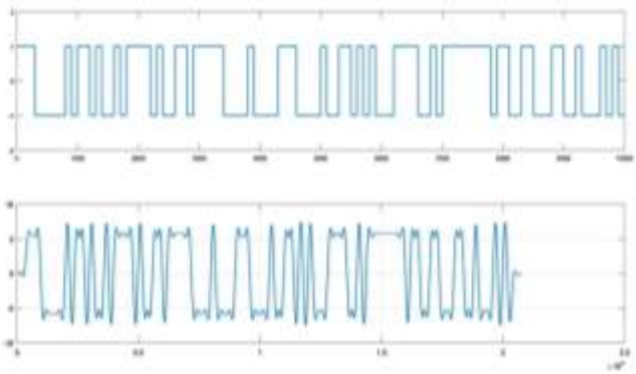

Fig.2 Pulse shaping of data using rrc filter

Modulation:

Now this shaped pulse modulated with the frequency 10MHz and gives modulated signal as shown in figure 3 spectrum of modulated signal also shown in figure here we can see that spectrum of modulated signal at 10MHz frequency and modulation scheme BPSK used for modulation which in only in two quadrant

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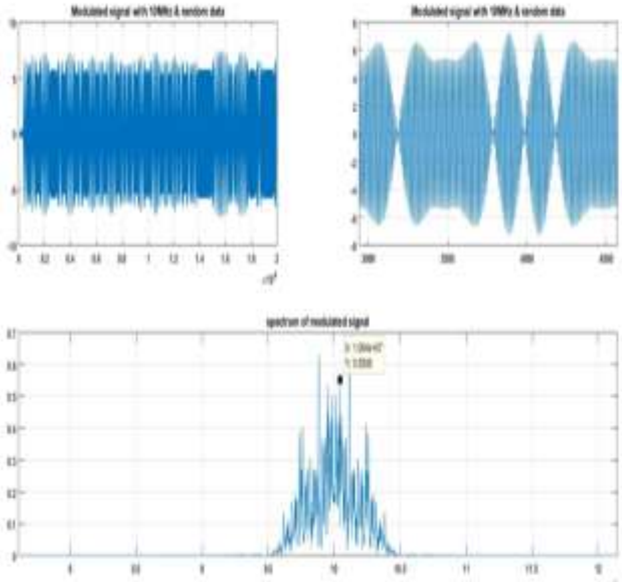

Fig.3 Modulation with 10MHz carrier frequency

Down conversion:

Down conversion of modulated signal is necessary to recover data for demodulation process using down converted signal converted to baseband signal which comes to zero IF so it can be easily proceed to demodulation baseband signal of single carrier modulated signal and its spectrum is shown in figure 4

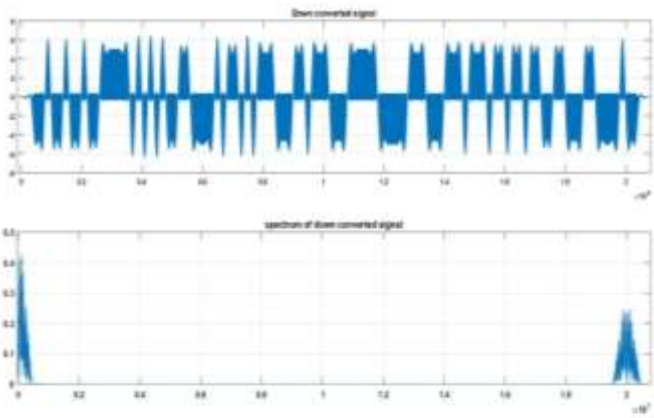

Fig.4 Baseband signal simulation in MATLAB

Carrier recovery:

Coherent detection and demodulation requires the utilization of synchronization systems that extract carrier phase and frequency information from the received signal. Phase and frequency are two parameters used by synchronization systems, such as Phase-Locked Loops (PLL) to track, acquire and synchronize to the carrier of the received signal. The carrier is used in the receiver to synchronize to, as the residual energy at carrier frequency is considered to be wasted energy as it does not transmit any data. In practice, techniques that conserve power are of interest, hence communications systems use suppressed carrier modulation/demodulation techniques, which do not require a residual energy at the carrier frequency. Using suppressed-carrier modulation techniques, present a problem for PLLs, since in the absence of the carrier, PLLs cannot track, acquire and synchronize to the received signal.Hence here we have used Costas loop for carrier recovery because of inherent advantagrs. The Costas loop is able to obtain the phase and frequency information of the modulated carrier and achieve phase tracking, acquisition and synchronization to this extracted carrier while demodulating and extracting the data contained in the received signal. The BPSK Costas loop block diagram is depicted in figure (2). It mainly consists of Phase Detector (PD), Low pass Filter (LPF), Loop Filter (LF) and Voltage Controlled

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Oscillator (VCO). The BPSK signals are sent to two multipliers of the upper branch called in-phase channel or I-channel and the lower branch called quadrature-phase channel or Q-channel respectively. The I-channel multiply the input by VCO's output, but the Q channel multiply input by VCO's output after 90-degree phase shift. The multiplier output of the I-channel and Q channel are passed through the arm filters, which are low pass filters, then multiply together to get the error signal. Finally, the error signal is filtered by the loop filter, whose output is control voltage that can control VCO's phase and frequency. When the carrier frequency and phase generated by VCO are coincident with the input signal's carrier frequency and phase, the demodulated signal can be extracted from the I-channel.

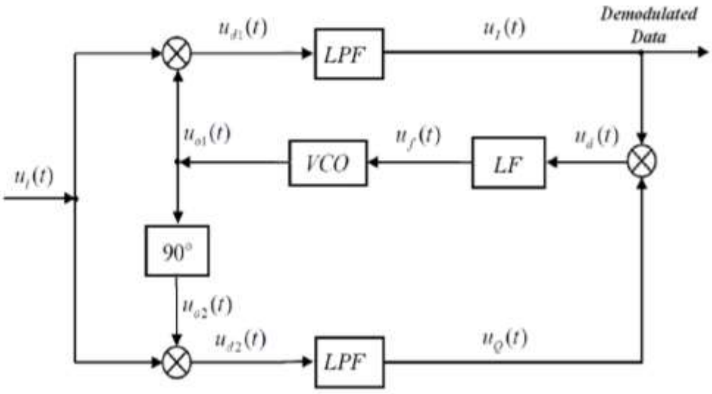

Fig. 4 costas loop block diagram

Costas loop simulation result as shown in following figure 5 which simulated in MATLAB

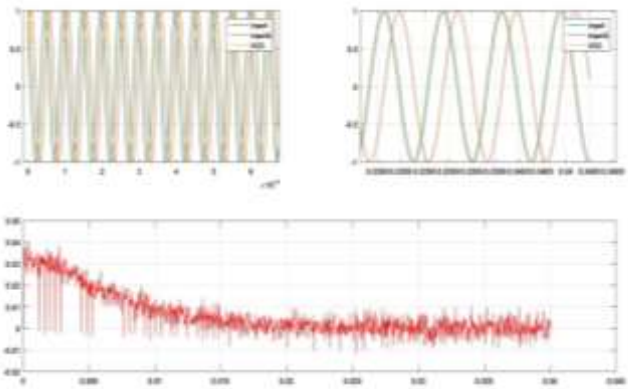

Fig. 5 costas loop simulation in MATLAB

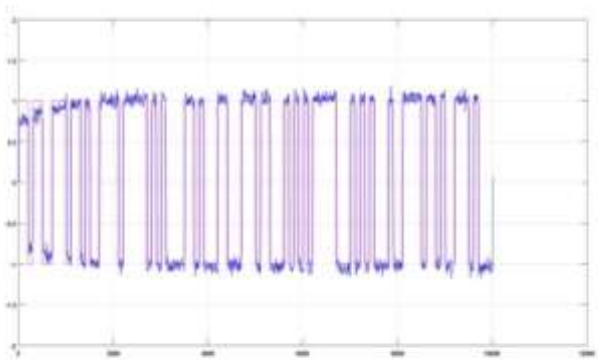

Fig. 6 Data recovery after costas loop

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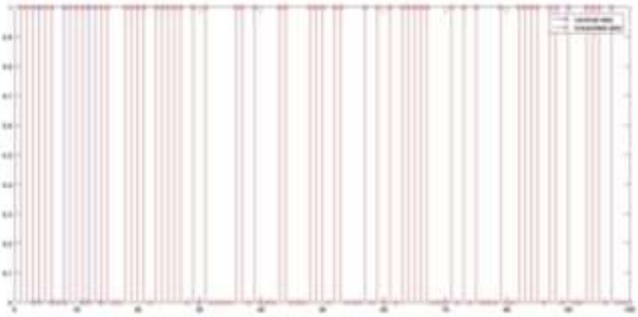
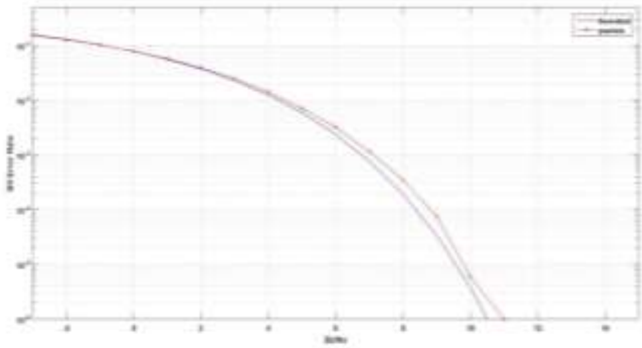


Fig.7 symbol detection simulation in MATLAB

Now measurement of bit error rate versus Eb/No graph shown in figure 8, as we can see in figure bit rate rate for 11 Eb/No is less than 10^{-6} theoretical analysis is for 10.6 Eb/No bit error rate is less than 10^{-6}



Fig, 8 Bit error rate measurement

above all simulation result is for single carrier demodulation, but finally dissertation goal is to simulation for multicarrier demodulator so that now this whole algorithm applied to multicarrier frequencies, as shown in figure 5.9 there are four frequencies 10M, 11M, 12M, 13M spectrum of modulated signal shown in figure so it can be easily understanding by anyone

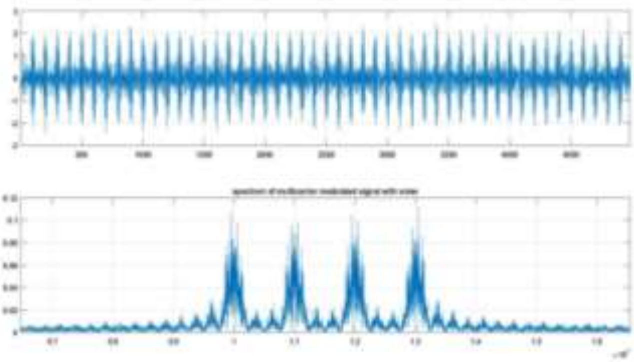


Fig.9 Combined four channel modulated signal

Combined four channel modulated signal shown in above figure as in single carrier demodulation down conversion of modulated signal in multicarrier demodulation process there is also down converter is required so as shown in figure 10 there is four frequency spectrum shown at 0 intermediate frequency

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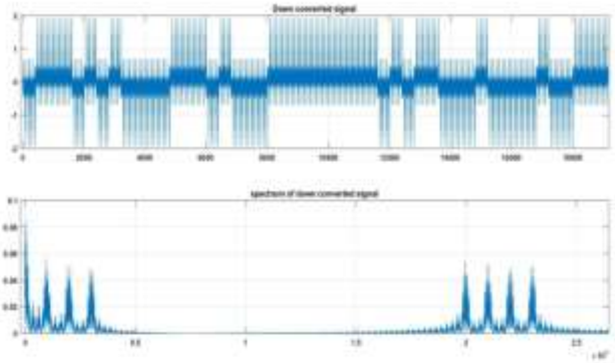


Fig,10 Down converted signal

After down conversion of signal filtering of signal is required because of desired frequency spectrum for demodulation process. Filtered signal as shown in figure 11

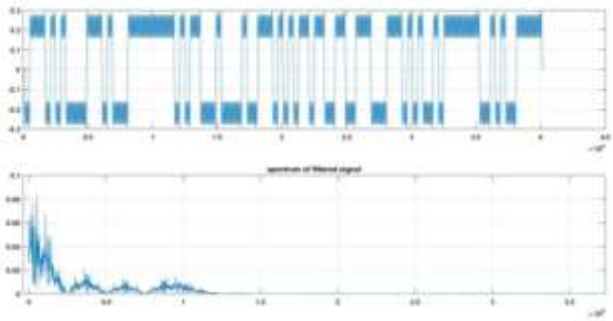
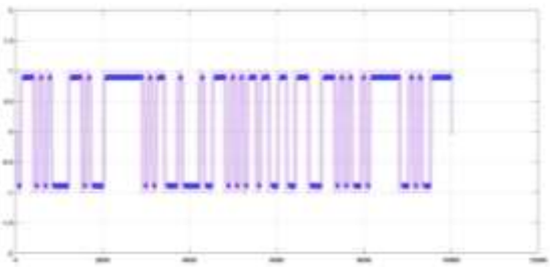
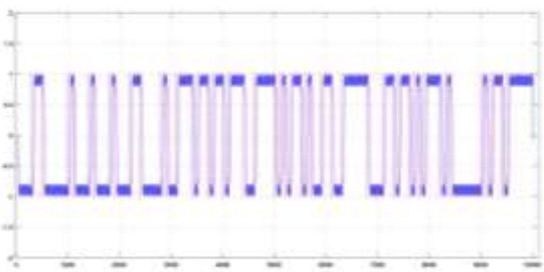


Fig. 11 Filtered signal

After filtering carrier recovery algorithm applied as shown in single carrier process after carrier recovery we receive data for different frequencies received data shown in figure 12,13,14,15



Fig, 12 Received data for 10MHz frequency



Fig, 13 Received data for 11MHz frequency

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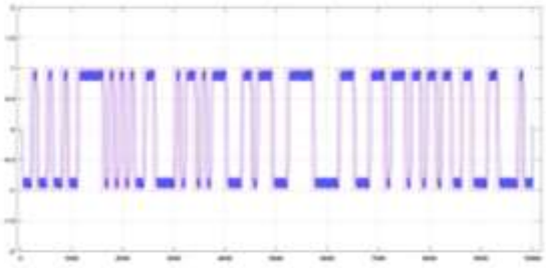
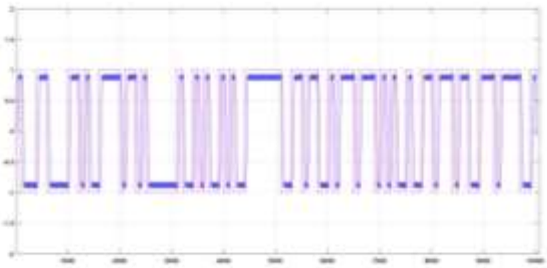


Fig, 14 Received data for 12MHz frequency



Fig, 15 Received data for 13MHz frequency

After this all finally receives bits which shown in figure 16 which is almost same as transmitting bits

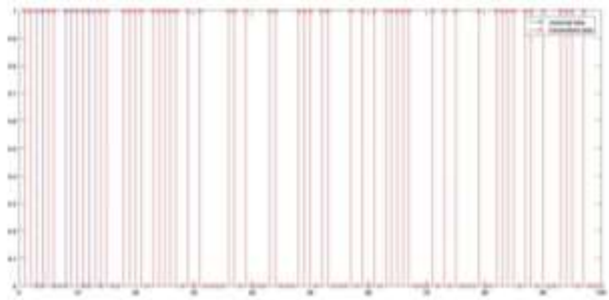


Figure 16 Received bits

IV. CONCLUSION

Multicarrier demodulator is beneficial for space requirement, power consumption. After this simulation results we can conclude that for pulse shaping RRC filter is used which eliminate harmonics of pulses. Costas loop algorithm is used for carrier recovery and we achieve 11 Eb/No for 10^{-6}-bit error rate. Here is 0.4 implementation margin due to carrier recovery and deduction.

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