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Comparison between Coherent and Non Coherent Technique for GMSK and MSK Signals

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Gaussian minimum shift keying is a spectrum efficient modulation scheme. The GMSK is better than normal MSK. For avoiding the interference between adjacent signals have to use GMSK modulation scheme.The coherent receiver implementing is easy. But the non-coherent receiver implementing is a complex. The non-coherent receiver produces a complex interference effects in a multipath channel. In this paper we present some analysis and performance between coherent and non-coherent receiver for GMSK and DQPSK and shows the simulation results.

Key words: GMSK,Modulation, Coherent Receiver, Non-coherent receiver

Frequency Shift keying has been used for data communication in a mobile radio environment. The minimum shift keying is a special form shift keying has a several good properties. The Gaussian minimum shift keying is an extension form of minimum shift keying. The original binary signal is passed through a Gaussian shaped filter before it is modulated with minimum shift keying. For preparing a GMSK the coherent receiver and non-coherent is important one. The coherent transmissions receiver knows about the transmission and what data is being sent out. But the non-coherent receiver doesn't know exactly what data is being sent out.

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The non-coherent communication needs to be a more complicated (both implementation of hardware and software) to operate correctly. Coherence implies a strict timing mechanism. The carrier phase is must in coherent systems at the receiver and they used a matched filters to detect which data was sent. But the non-coherent is opposite of coherent. The carrier phase information is not needed. And the non-coherent system has used methods like square law to recover data. For coherent receiver have to concentrate on the carrier recovery and timing recovery[1]. For non-coherent receiver carrier recovery is not necessary. For designing the high performance coherent and non-coherent receiver we need to concentrate on SNR value and bit error rate. To compare the performance of both in terms of BER with respect to signal to noise ratio(SNR).coherent and non-coherent receiver proposed by using synchronization algorithm[2]

GMSK BACKGROUND

Gaussian Filter

The coherent detection performs better than non-coherent detection. We accept coherent detection for power efficiency. The main use of synchronization is coherent detection. The main use of timing synchronization is to estimate the correct the correct sampling times to reduce the inter symbol interference. Gaussian filter is mainly used to regulate the changed bandwidth of the signal.

The Gaussian filter is represented by bandwidth and time product (B is the -3 dB bandwidth and T is the symbol period T=1/F).The Bandwidth of the BT is determined by the width of the Gaussian filter.For GSM the BT product is 0.3 and CDPD the bandwidth time product is 0.5.the impulse response of the Gaussian filter as shown in fig 1[4]

The digital modulation can be adopted BT=0.28 for conventional UHF (300-1000 MHZ). Without carrier frequency drift the mobile radio communication where the contiguous channel to the total power in the covet channel should be lower than -60DB[6]

Minimum shift keying

Minimum shift keying is a continuous phase frequency shift keying .FSK is the digital equivalent of frequency modulation with modulation index h=0.5.MSK is termed as minimum shift keying. The minimum shift keying has used two frequencies which are scattered by 1/2T and phase disruption is avoided in symbol boundaries[8]. The MSK transmission is a variant of Offset-QPSK technique. Here the coherent demodulation with bit error rate of MSK using 2T time) is equivalent to that of BPSK. The channel is assumed to be AWGN.

$$P_e=1/2 \exp(-1/2\, E_b/N_o)$$

P_e-is the probability of bit error

Gassuian minimum shift keying

MSKinclude with a Gaussian filter is called as GMSK. It is a binary modulation scheme which is derived from MSK. The MSK modulation index is 0.5.MSK has a BT product of infinity. The fig 3 shown the GMSK generation scheme.The BT product of 0.3 was chosen for the GSM standard as a compromise between spectral efficiency and ISI .the Gaussian filter converts the full response message signal into a partial response scheme where each transmitted symbol several bit periods[3] The Gaussian filter impulse response is given by

$$H_g(t) = ð/a \exp(-ð^2/a^2 t^2)$$

And transfer function is given by

$$H_g(f)=\exp(-á^2f^2)$$

In AWGN model as the Gaussian noise is directly added with the signal and information signal gets converted into the noise. Here the s (t) is transmitted signal, n (t) is a white Gaussian noise and r (t) is the received signal.

$$R(t)=s(t)+n(t)$$

Bit error rate:

The bit error rate or bit error ratio is the number of bits divided by the total number of transmitted bytes. The BER is the main one for all modulation scheme. The BER may be affected by

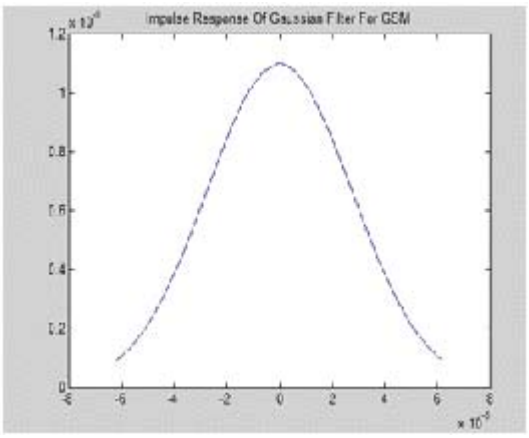

Fig. 1. Gaussian Filter Impulse Response for GSM

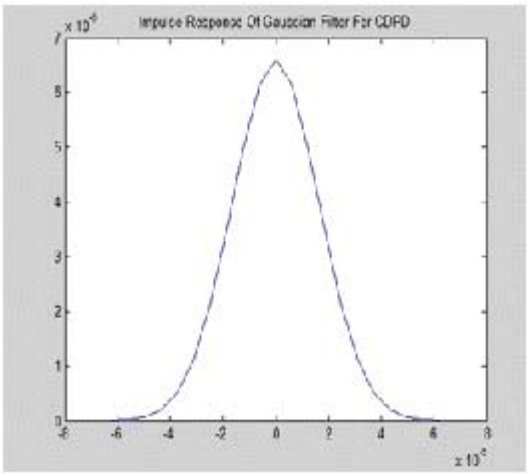

Fig. 2. Gaussian Filter Impulse Response for CDPD

noise, inter-symbol interference. The BER improved by choosing the strong signal strength.

$$BitErrorRate = \frac{No\ of\ bit\ errors}{Total\ no\ of\ bits\ transfered}$$

Because of the ISI introduction by the Gaussian filter BERs of coherent and non-coherent value will be degraded from these optimum values.

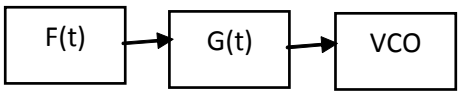

Fig. 3. GMSK Scheme

Table 1. Comparision between MSK and GMSK

SNR	BER (MSK)	BER(GMSK)
0	0.5	0.3032
1	0.4506	0.2664
2	0.3549	0.2263
3	0.2664	0.1843
4	0.1894	0.1424
5	0.1267	0.1028
6	0.0792	0.0683
7	0.0459	0.0407
8	0.0242	0.0213
9	0.0114	0.0094

Simulation results:

Comparison between MSK and GMSK:

The bit error rate between MSK and GMSK is verified for different values using SNR using MATLAB. Table 1 shows the BER variation between MSK and GMSK[3].

The above results shows that BER performance of GMSK. When we increase the SNR value the BER rate automatically will reduce. The GMSK BER rate is higher than BPSK. The below diagram shows that the BER variation of MSK. That diagram tells that variation between SNR and BER. The GMSK value is quite higher than MSK.by increasing the number of transmitted symbols we can reduce the GMSK probability of error[5].

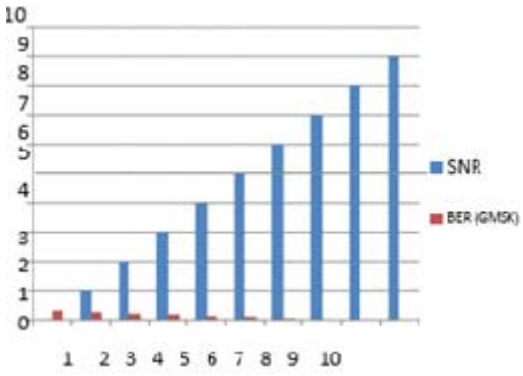

Fig.4. BER performance of GMSK

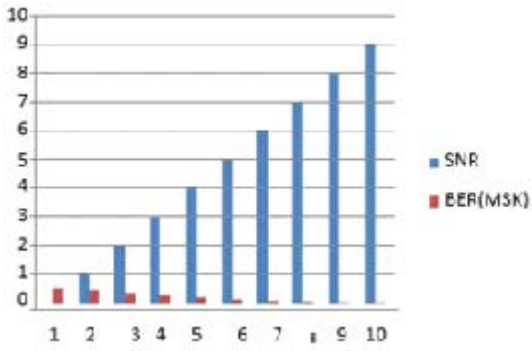

Fig. 5. BER performance of MSK

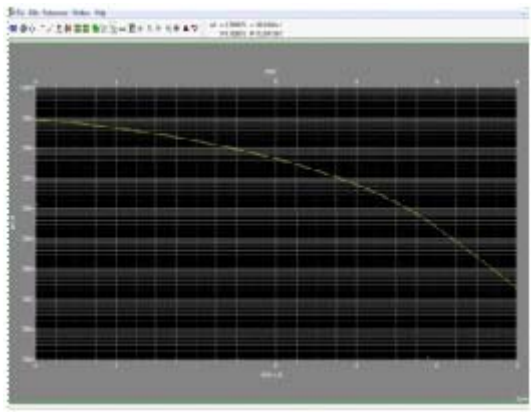

Fig. 6. BER curve of GMSK

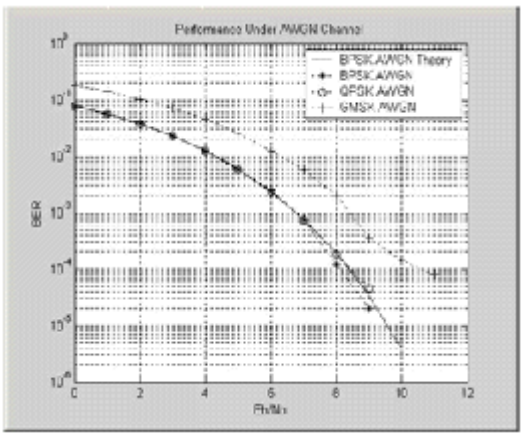

Fig. 7. A Comparison graph for AWGN Channel for BPSK, QPSK and GMSK.

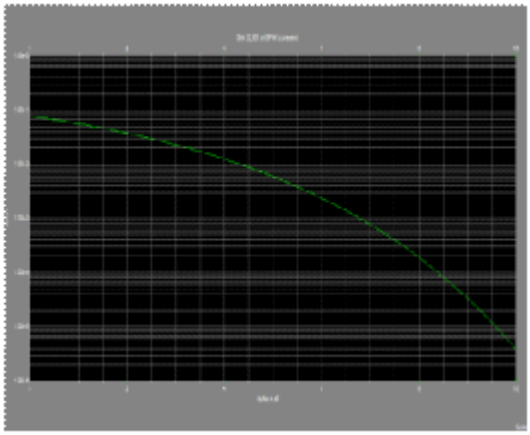

Fig. 8. BER of Curve BPSK

Comparision results of BPSK, QPSK AND GMSK:

For comparing the BPSK, QPSK and GMSK based transmission under some different channel. The channel named as AWGN, one path fading and four path fading channel.

Binary phase shift keying:

BPSK also called as PRK (phase reversal keying). Basically BPSK means signal value switched between two values. Those values are 1 or 0.for generate a BPSK signal the equivalent phase reversal is compulsory. A synchronous demodulator would be perceptive to these phase reversals. For calculate the spectrum of binary sequence then we must know about the bandwidth of the BPSK itself[4]

The comparison between BPSK and GMSK graph was shown above. Depends on the results BPSK and QPSK both are same. For obtaining the 0 BER less signal power is needed[6]

CONCLUSION

The goal of this research is to find out which modulation scheme is best for the radio environment. Comparing the BER for MSK and GMSK the simulated results are acceptable. From these results it can be observed that getting a 0 BER BPSK requires less signal power. For comparing the BER performance GMSK significantly higher than BPSK. Designing the coherent and non-coherent receiver for GMSK signal is quite complex. The SNR and BER value will determined the signal quality.GMSK requires more bandwidth to effectively recover the carrier. By increasing the number of transmitted symbols we can reduce the GMSK probability of error.

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