International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 3, March - 2013

Performance analysis on SNR, BW, SSP, UBF, LBF to get acceptable bit error rate to improve power efficiency and Channel capacity.

Dr. K. PADMA PRIYA

Associate Professor, Department of Electronics and Communication Engineering, JNTUK College of Engineering, Vizianagaram

---

I. ABSTRACT

This paper describes the concepts of acceptable bit error rate, power efficiency(energy efficiency), band width efficiency, (SNR)Input, (SNR)output, significant side band pair(SSP), upper bound frequency(UBF), lower bound frequency(LBF).This paper also presents relation between SNR and band width in frequency modulation. Frequency modulation is frequently used modulation technique and is known as "angle modulation". Angle modulation varies carrier(sinusoidal signal) signal in such a way that the angle of the carrier signal varies in according to the amplitude of the baseband modulating signal. In this method , the amplitude of the carrier wave is kept constant but in this paper I am changing the amplitude of the carrier and observed the what type of changes takes place in order to improve the understanding capability of the reader, two important classifications of angle modulation are i)frequency modulation ii) phase modulation.

There are different modulating techniques but some techniques are better in terms of bit error rate performance, some methods are better for band width efficiency. Here my intention is to make these methods good at both i.e acceptable bit error rate and band width efficiency.

Key words:, Efficiency(ή, Channel capacity Peak frequency deviation, Frequency modulation index, Modulation frequency,(SNR)in, (SNR)output, bit error rate,

II. INTRODUCTION

In a digital communications signal received at the receiver is the very important criteria if channel capacity is more signal will be very strength it will be possible only by maintaining proper signal to noise ratio, proper band width efficiency, low bit error rate, proper significant side band pair, upper bound frequency, lower bound frequency, audio band width. By maintaining all the parameters above said then we will improve band width efficiency, power efficiency(energy efficiency) which leads to increase in channel capacity and throughput(2).

The signal-to-noise ratio, the bandwidth, and the channel capacity of a communication channel are connected by the Shannon–Hartley theorem. Assumes thermal noise only C/BW measures the efficiency of a digital transmission, BW, S and N are not independent: (1)The noise N increases with the bandwidth of W (2) Inter modulation noise increases with the signal strength S. The bit error rate or bit error ratio (BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval. BER is a performance measure, often expressed as a percentage (2). The BER may be improved by choosing a strong signal strength (unless this causes cross-talk and more bit errors), by choosing a slow and robust modulation.

III.SIGNAL TO NOISE RATIO (SNRatio)

Signal-to-noise ratio is a measure used in science and engineering that compares the level of a desired signal to the level of background noise(3). It is defined as the ratio of signal power to the noise power. A ratio higher than 1:1 indicates more signal than noise. While SNR is commonly quoted for electrical signals, it can be applied to any form of signal (such as isotope levels in an ice core or biochemical signaling between cells).

Signal to noise ratio:

$(S/N)_{Db}$=10log (signal power/noise power.)

Typically measured at the receiver, because it is the point where the noise is to be removed from the signal.

The signal-to-noise ratio, the bandwidth, and the channel capacity of a communication channel are connected by the Shannon–Hartley theorem.

Signal-to-noise ratio is sometimes used informally to refer to the ratio of useful information to false or irrelevant data in a conversation or exchange. The theoretical maximum SNR assumes a perfect input signal. If the input signal is already noisy (as is usually the case), the signal's noise may be larger than the quantization noise. Real analog-to-digital converters also have other sources of noise that further decrease the SNR compared to the theoretical maximum from the idealized quantization noise, including the intentional addition of dither(6).

Although noise levels in a digital system can be expressed using SNR, it is more common to use E_b/N_o, the energy per bit per noise power spectral density. The modulation error ratio (MER) is a measure of the SNR in a digitally modulated signal.

IV.BAND WIDTH

Band width efficiency explains about the ability of modulation scheme to accommodate data with in a limited band width .Band width efficiency reflects how efficiently the allocated band width is utilized and is defined as the ratio of throughput data rate per hertz in a given band width(6).

bandwidth Limitations arise from the physical properties of the transmission medium and from deliberate limitations at the transmitter to prevent interference from other resources.

Band width efficiency $(\dot{\eta})_{BW}$=data rate in bits per second/BW occupied by RF signal=$D_{RATE}/(BW)_{RF(3)}$

V. CHANNEL CAPACITTY(C)

A given communication system has a maximum rate of information known as the channel capacity.
If the information rate *R* is less than *C*, then one can approach arbitrarily small error probabilities by using intelligent coding techniques(8).

To get lower error probabilities, the encoder has to work on longer blocks of signal data. This entails longer delays and higher computational requirements

Nyquist's Law $C = 2W \log_2 M$

Assumption: noiseless channel

bits per second

BW = bandwidth

M = number of encoding levels in the signal

Binary signals can be reconstructed by taking 2W samples per second

A 5 kHz channel with binary signals can transmit at most 10,000 bps

The limitations is due to the effect of inter symbol interference, such as is produced by delay distortion.

Shannon's Law $C = 2W \log_2 (1 + SNRatio)$

S = signal strength

N = noise strength

Assumes thermal noise only C/BW measures the efficiency of a digital transmission .BW, S, and N are not independent: (1)The noise N increases with the bandwidth of W (2) Inter modulation noise increases with the signal strength S.

VI. PEAK FREQUENCY DEVIATION AT CONSTANT GAIN 10KHZ/V.

Let the gain is $\dot{\eta}$, peak frequency deviation $\Delta f=(AM)_C X \dot{\eta}$ $(AM)_{C=}$Amplitude of carrier

S.no	$(AM)_C$	Peak frequency deviation $\Delta f=(AM)_C \times \dot{\eta}$
1	*5*	*50*
2	*10*	*100*
3	*15*	*150*
4	*20*	*200*
5	*25*	*250*
6	*30*	*300*
7	*35*	*350*
8	*40*	*400*

9	*45*	450
10	50	500

TABLE-

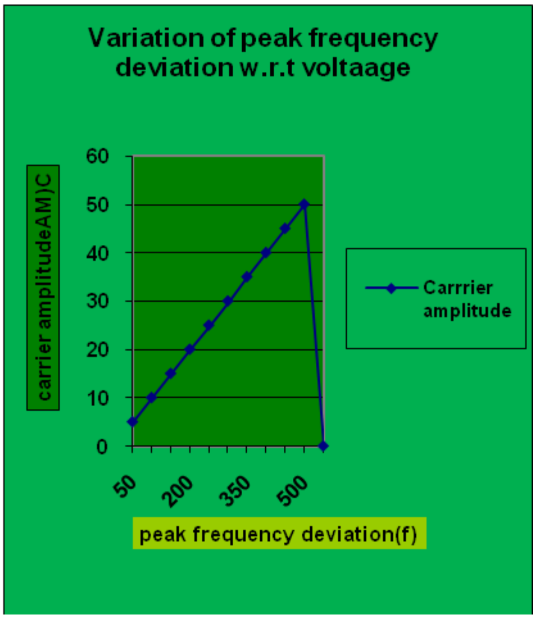

Figure-1

We observed that the graph between $(AM)_C$ &Peak frequency deviation(Δf) is linear.

VII. BIT ERROR RATE(BER)

In digital transmission, the number of bit errors is the number of received bits of a data stream over a communication channel that have been altered due to noise, interference, distortion or bit synchronization errors.

The bit error rate or bit error ratio (BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval. BER is a unit less performance measure, often expressed as a percentage(5).

The bit error probability p_e is the expectation value of the BER. The BER can be considered as an approximate estimate of the bit error probability. This estimate is accurate for a long time interval and a high number of bit errors(10).

Factors affecting the BER

In a communication system, the receiver side BER may be affected by transmission channel noise, interference, distortion, bit synchronization problems, attenuation, wireless multipath fading, etc.

The BER may be improved by choosing a strong signal strength (unless this causes cross-talk and more bit errors), by choosing a slow and robust modulation scheme or line coding scheme, and by applying channel coding schemes such as redundant forward error correction codes.

The transmission *BER* is the number of detected bits that are incorrect before error correction, divided by the total number of transferred bits (including redundant error codes). The information BER, approximately equal to the decoding error probability, is the number of decoded bits that remain incorrect after the error correction, divided by the total number of decoded bits (the useful information). Normally the transmission BER is larger than the information BER. The information BER is affected by the strength of the forward error correction code. The BER may be analyzed using stochastic computer simulations. If a simple transmission channel model and data source model is assumed, the BER may also be calculated analytically(7).

VII. VARIATION BETWEEN PEAK FREQUEENCY DEVIATION(Δf) AND FREQUENCY MODULATION INDEX.

S. no	Δf(khz)	f_{mod}	$M_{INDEX}= \Delta f/f_{mod}$
1	50	10	5
2	100	10	10
3	150	10	15
4	200	10	20
5	250	10	25
6	300	10	30
7	350	10	35
8	400	10	40
9	450	10	45
10	500	10	50

Table-2

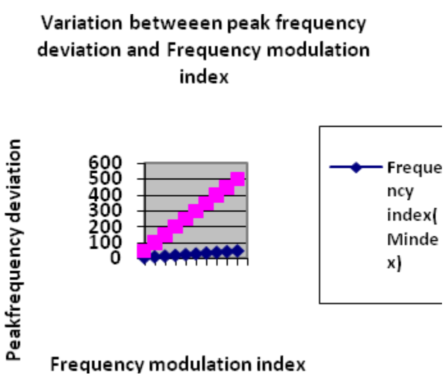

Chart-2

Observations: By increasing peak frequency deviation there is 1/10TH increase in Modulation index.

VIII. VARIATION OF CHANNNEL CAPACITY (C) WITH BAND WIDTH(RF) AND (SN_{RATIO})output

$C=(BW)_{RF}\ LOG_2(1+SN_{RATIO})$

S.no	BW	$(SN_{RATIO})_{OUTPUT}$	C
1	300hz	5dB	617.83
2	300hz	10 dB	1037.829
3	300hz	15 Db	1508.331
4	300hz	20 dB	1997.463
5	300hz	25 dB	2492.811
6	300hz	30 dB	2990.167

Table-3

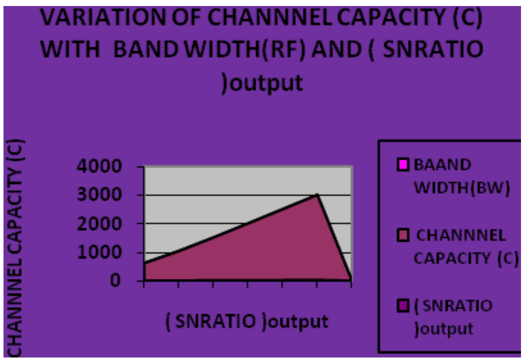

Chart-3

IX. COMPARRISION BETWEEN Δf(KHZ), M_{INDEX}(KHZ), SSP, UBF(KHZ), LBF(KHZ),Where(BW)$_{AUDIO}$=15

Let Δf=peak frequency deviation, M_{INDEX}=modulation index, SSP=significant side band pair, ,UBF=Upper bound frequency, LBF=Lower bound frequency

SSP=M_{index}+1, ---(1)

UBF=2(M_{INDEX}+1)(BW)$_{AUDIO}$-------------------------------------(2)

LBF=2XΔf---(3)

S. no	Δf	M_{INDEX}	SSP	UBF	LBF
1	50	5	6	180	100
2	100	10	11	330	200
3	150	15	16	480	300
4	200	20	21	630	400
5	250	25	26	780	500
6	300	30	31	4930	600
7	350	35	36	1080	700
8	400	40	41	1230	800
9	450	45	46	1380	900
10	500	50	51	1530	1000

Table-4

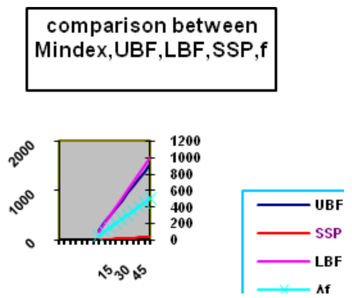

Figure-4

Observation from this graph : For small audio band width there is large increase in Modulation index.

XIII. VARIATION OF CHANNNEL CAPACITY (C) WITH BAND WIDTH AT CONSTANT (SN_{RATIO})output

C=(BW)$_{RF}$ LOG$_2$(1+SN_{RATIO})

S.no	BW(KHZ)	**(SN_{RATIO})OUTPUT**	C(kbps)
1	100KHZ	10 dB	345.9429
2	200KHZ	10 dB	691.886
3	300KHZ	10 dB	1037.829
4	100KHZ	20 dB	665.821
5	200KHZ	20 dB	1331.642
6	300KHZ	20 dB	1997.463
7	100KHZ	30 dB	996.722
8	200KHZ	30 dB	1.99mbps
9	300KHZ	30 dB	2.99mbps

Table-5

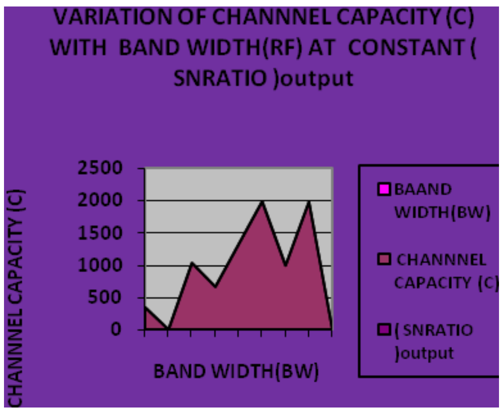

Figure-5

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 3, March - 2013

X. VARIATION OF $(\mathbf{SNRatio})_{index}$ WITH FREQUENCY MODULATION INDEX $(\mathbf{M}_{index})$ AT CONSTANT(K)

Where $\Delta f = (AMP)_{carrier}\ \acute{\eta}$------(1)

$M_{index} = \Delta f / f_{mod}$------------------------------(2)

From equations 1&2

$M_{index} = (AMP)_{carrier}\ \acute{\eta} / f_{mod}$---------(3)

$(AMP)_{carrier} = (M_{index} \times f_{mod}) / \acute{\eta}$----(4)

(or)

$\acute{\eta} = (M_{index} \times f_{mod}) / (AMP)_{carrier}$--------(5)

Relation between (SNRatio)input and M_{index}

(SNRatio)input, AM$= (AMP)^2_{carrier} / 2N_W (BW)_{RF}$

$= [(M_{index} \times f_{mod}) / \acute{\eta}]^2 / 2N_W (BW)_{RF}$------(6)

(or)

$[(M_{index} \times f_{mod})]^2 / 2\ \acute{\eta}^2\ N_W (BW)_{RF}$--------(7)

where N w= white noise, $(BW)_{RF}$=RF Band width

(SN Ratio)input, AM α M^2 index------(8)

(SN Ratio)input=K M^2 index----------(9)

Where $K = [(f_{mod})]^2 / 2\ \acute{\eta}^2\ N_W (BW)_{RF}$------(10)

BY Substituting the values f_{mod}=10 khz, $\acute{\eta}$=10

N_w=200hz, $(BW)_{RF}$=300HZ (at front end of the receiver.)(author)

XI. POWER EFFFICIEENCY $(\acute{\eta})_{POWER}$

Performing power analysis and sample size estimation is an important aspect of experimental design, because without these calculations, sample size may be too high or too low. If sample size is too low, the experiment will lack the precision to provide reliable answers to the questions it is investigating. If sample size is too large, time and resources will be wasted, often for minimal gain(2&8).

S. no	**M index**	**K**	**(SNRatio) input**
1	5	8.334	41.67
2	10	8.334	83.34
3	15	8.334	125.01
4	20	8.334	166.68
5	25	8.334	208.35
6	30	8.334	250.02
7	35	8.334	291.69
8	40	8.334	333.36
9	45	8.334	375.03
10	50	8.334	416.7

Table-6

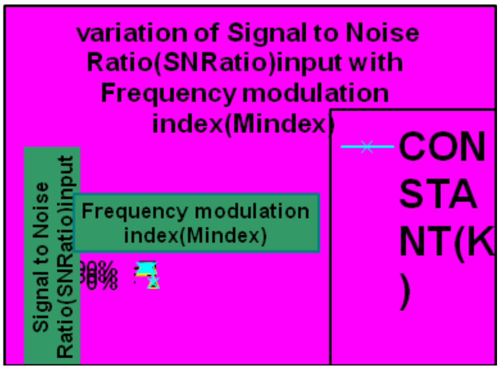

Figure--6

In some power analysis software programs, a number of graphical and analytical tools are available to enable precise evaluation of the factors affecting power and sample size in many of the most commonly encountered statistical analyses. This information can be crucial to the design of a study that is cost-effective and scientifically useful.

To ensure a statistical test will have adequate power, you usually must perform special analyses prior to running the experiment, to calculate how large an *N* is required.

Let's briefly examine the kind of statistical theory that lies at the foundation of the calculations used to estimate power and sample size. Return to the original example of the politician, contemplating how large an opinion poll should be taken to suit her purposes (11).

Statistical theory, of course, cannot tell us what will happen with any particular opinion poll. However, through the concept of a sampling distribution, it can tell us what will tend to happen in the long run, over many opinion polls of a particular size.

XIII. CONCLUSION

Now a days, an increasing demand of wireless& mobile communications it requires high quality of transmission with less price, it is possible only with high quality research .This paper may gives complete idea to minimize noise effects by maintain proper parameters by adopting the above numerical approximations, graphical representations and tabular forms.

XIV. ACK NOWLEDGEMENT

The author would like to thank to Pro.CH.D.V.Paradesi Rao, Arora Engineering College, Bhongiri, Hyderabad for giving their valuable suggestions& guide lines.

XIV.REFERENCES

1.John D Kraus, Ronald J Marheka, Ahmad S Khan, Antennas and Wave propagation, 4thEdition(2010), Tata M_cGraw Hill, New Delhi.

2. Theodore S. Rappaport, Wireless Communications, Principles and practice, second edition.

3. Sanjay Sharma, Wireless& Cellular Communications, second edition.

4. K.D. Prasad, Antenna and Wave propagation,

3rdEdition,New Delhi.

5. Fock, V.A Electromagnetic Diffraction and Propagation Problems, pp 254-275, Pergamum Press, New York, 1965.

6.Wait, J.R: “Electromagnetic surface waves”, Advances in Radio Research,1, New York, Academic press pp. 157-219,1964.Academic press

7. Walker, J. Halliday, D., & Resnick, R. (2011). Fundamentals of physics. Hoboken, NJ: Wiley.

8. Soundrya Rajan. V.: Antenna Theory and and Wave propagation”, Scitech Publications(India) Pvt.Ltd,Chennai,2001. 3rdEdition, New Delhi. “ Anderson, Leland I. (2002).

9.Dhar,p.c.: “Electromagnetic Field Theory, “Antenna Theory and Wave propagation”, Dhanpat Publishing Co. Pvt Ltd, New Delhi ,2001.

10. Gautam, A.K.: “Antenna and Wave propagation”, S.K. Kataria and Sons, Delhi, IIND Edition,2004.

11. C. Balannis, Antenna Theory-Analysis and Design. .New York: Wiley, 1982.