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# A comparative analysis on fundamental of Speech Signal and Noise using different Channels and Modes

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## Abstract:

Signal is essential in our daily life for evaluating our daily activities. Signal is a function of one or more variables which conveys information, such as analog signal, digital signal, continuous tine signal, discrete time signal etc. But sometimes unwanted signals are included into the message signal, which is termed as a noise, As a result, we can't get the appropriate signal at the receiver end. So, we should to find out the best way, how to minimize this noise effect in original signal.

In this paper we have evaluated the performance of bit error rate with respect to SNR for different channels (AWGN, Rician, Rayleigh) for finding the best channel and also investigated the performance of different mode for finding error less signal transmission. From the simulation results, it is viewed that AWGN channel is the best channel and Rayleigh channel is the worst channel and data mode carries as small bit, the result is better for error less signal transmission.

*Keywords* **—Signal to Noise Ratio (SNR), Bit Error Rate (BER).**

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## I. INTRODUCTION

Signals are defined as a function of one or more variables that relays information depends on the nature of a physical phenomenon. We experience signals of various types almost on a continual basis in our daily life. The blowing of the wind is an example of a continuous wave. When we speak, continuous signals are generated. These spoken word signals travel from one place to another so that another person can hear them. Mathematically, we describe a signal as a function of one or more independent variables. For example, the functions

$$S(t) = 5t$$

$$S(t) = 20t \qquad (1.1)$$

describe two signals. One that varies linearly with the independent variable (time) and a second that varies quadratically with t [1].

In a communication system the information pass through a channel, known as medium. At first the signal is generated by a source and it is transmitted by a transmitter then pass through a medium and finally reached to the destination or receiver [2]. The general steps of a communication system are given in Figure 1.1.

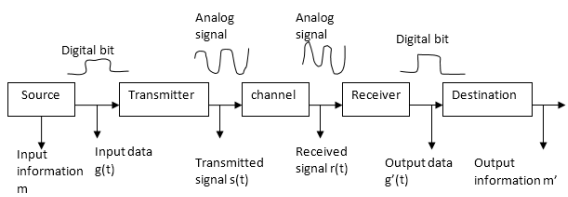



**Fig1.1: Simplified general communication system.**

In digital communication system three basic signal processing operation are identified: source coding, channel coding, and modulation shown in Figure 1.2. In source coding the encoder maps the digital signal generated at the source output in digital form provides a reduced bandwidth. The mapping is one to one, which provides a reduced bandwidth requirement. In channel coding the objective is for the encoder to map the incoming digital signal into a channel input and for the detector the channel output into an output digital signal. The combined role of channel encoder and decoder is to provide for reliable communication over a noisy channel [3].

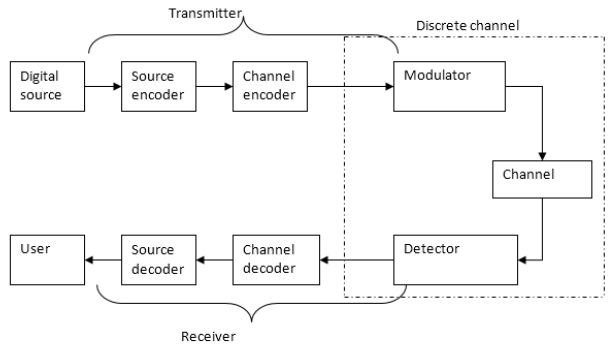



Fig1.2: Block diagram of digital communication system

## II. CHANNELS AND MODES

This section contains the summary of different channels namely AWGN , Richian, Rayleigh channel and different modes contains several data bits.

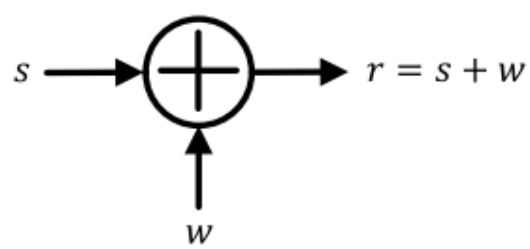
### A. AWGN Channel

The term additive white Gaussian noise (AWGN) originates due to the following reasons:

- **[Additive]** Noise is additive, i.e., the received signal is equal to the transmitted signal plus noise. This gives the most widely used equality in communication systems.

  r(t)=s(t)+w(t)

  which is shown in Figure below. Moreover, this noise is statistically independent of the signal.




- **[White]** It is like the white colour that is composed of all frequencies in the visible spectrum, white noise refers to the idea that it has uniform power across the whole frequency band. As a consequence, the Power Spectral Density (PSD) of white noise is constant for all frequencies ranging from −∞−∞ to +∞+∞, as shown in Figure below.


In words, each noise sample in a sequence is uncorrelated with every other noise sample in the same sequence. Therefore, mean value of a white noise is zero.

- **[Gaussian]** The probability distribution of the noise samples is Gaussian with a zero mean, i.e., samples can acquire both positive and negative values and in addition, the values close to zero have a higher chance of occurrence while the values far away from zero are less likely to appear. This is shown in Figure below. As a result, the time domain average of a large number of noise samples is equal to zero.

AWGN is a noise that affects the transmitted signal when it passes through the channel. It contains a uniform continuous frequency spectrum over a particular frequency band [4].

### B. Rayleigh Channel

The Rayleigh channel is a commonly used model to describe the statistical time varying nature of the envelope of the flat fading signal or envelope of an individual multipath component. The transmitted signals are scattered because of the obstacles in the environment before they reach the receiver [5].

### *C. Rician* Channel

Rician channel model is the same as the Rayleigh channel model and it has strong dominant component in the Rician channel model that has non fading signal or stationary signal known as line of sight. When there is a stationary signal dominant component present in the line of sight, propagation path with envelope distribution in small scale fading is called Rician [5].

### D. Data mode

Several data mode are used for the purpose of information transmission. Data bit stream called data block which is composed of 4bit, 8bit, 16bit, 32bit, 64bit. From the simulation it is seen that lower data stream conveys less error data transmission process.

## III. SIMULATION RESULT

### A. Signal to Noise Ratio

The signal to noise ratio : (SNR): It is defined as the ratio of signal power to noise power. The quality of optical and other measurements is often characterized with a signal-to-noise ratio (SNR, S/N ratio). It is often expressed in decibels [6].
If signal power is p(x) and noise power is n(x)
Then

$$SNR=p(x)/n(x) \tag{3.1}$$

### *B.* Bit Error Rate (BER)

In communication system, 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 [6]. As an example, assume this transmitted bit sequence:
0 1 1 0 0 0 1 0 1 1,
and the following received bit sequence:
0 0 1 0 1 0 1 0 0 1,
The number of bit errors (the underlined bits) is in this case 3. The BER is 3 incorrect bits
divided by 10 transferred bits, resulting in a BER of 0.3 or 30%.

However,
Eb/No: In digital communications, where the information is contained in the transmitted bits, the ratio of the signal energy per bit to average noise power spectral density is commonly written as

Eb/No. The AWGN Channel relates Eb/ No, and SNR according to the following equations:

SNR = Eb/ No + 10log10(k) in dB

For the simulation, we used a random signal, generated randomly and that is modulated and transmitted through different channel, where noise is added, then it is demodulated and find out the bit error rate with respect to SNR. Shown in Figure1.4 Since AWGN added the white noise, whose impact is so small, for this reason its performance is best.

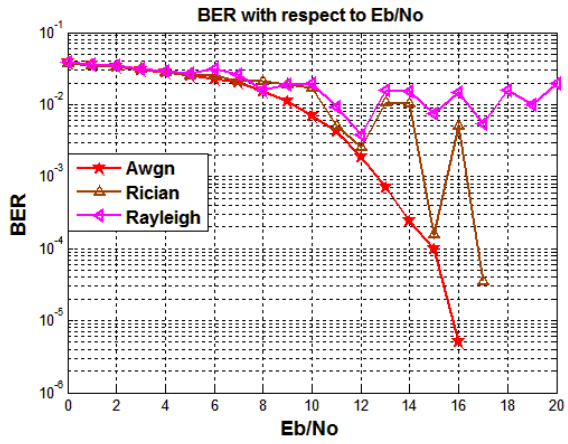



**Figure1.3: BER with respect to SNR using different channel**

Figure 1.4 shows the BER with respect to SNR using different mode, from the simulation it is shown that , if the data stream size is less then the bit error rate is small. Data mode with small size require more error less data transmission.

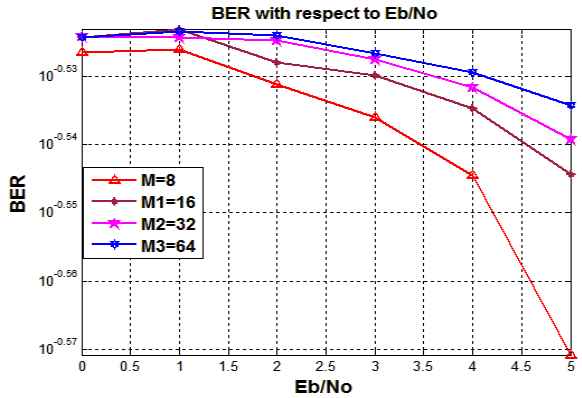



**Figure1.4: BER with respect to SNR using different mode**

## IV. CONCLUSION

Signals are also termed as information. So, error free signal is essential in our daily life, but it is corrupted with unwanted signal, known as noise. So it is essential that, how we can minimize the error from the transmitted signal at the receiver end. For minimizing error, different kinds of channel are used, and different bit stream or data mode is used. Finally, it is seen that the performance of AWGN channel is better than others channel.

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