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Preamplification of Signal between Satellites

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***Abstract*— Intersatellite communication is the process of transmitting information between satellites. Optical communication in intersatellite system involves the process of transmitting information with light as carrier wave. While transmitting information due to some noises or any other external factors some losses may occur. In this study the reduction in nose by the use of preamplifier at the receiver end may be analyzed. Preamplifier is said to have the capability of detecting and correcting errors. Hence in the output graph we may obtain the increase in signal strength with the reduction in noise. Bit Error Rate calculation may also be done. Telescope used in the block may act as terminating equipment which may reduce the reduction in cost of the entire system.**

***Index Terms*—Bit Error Rate, Intersatellite, Optical, Preamplifier**

I. INTRODUCTION

Optical communication has been emerging from wired to the wireless connection. Intersatellite communication system also makes use of this optical communication. Intersatellite communication is performed in order to transfer information between two satellites [9]. Transmission capacity, distance of optical system, signal strength etc. are some of the major factors in this optical communication [7]. In the existing model, preamplifier has been used in communication between base station and the satellite system. But in this study we are going to implement this preamplifier at the receiver part for the communication between two satellites. The basic components of the satellite communication system include transmitter, receiver and tracking, pointing system. Every system is said to have normal amplifier which only amplifies the signals that have been received. The tracking and pointing system is used for locating the position of receiver satellite. While using this normal amplifier error detection and correction is considered to be a risk factor.

II. SYSTEM DESCRIPTION

The basic components of the proposed intersatellite communication system may include transmitter, optical wireless channel, receiver which includes preamplifier and tracking, pointing system. Laser can be used as the optical source in transmission through wireless channel [6].

A. Transmitter

Transmitter may include modulator and laser source. Pulse width modulation has been used for modulation purpose. Input signal which is in electrical form may be modulated by ordinary carrier signal and by using some Light Emitting Diodes it is converted to optical form. This optical signal may be mixed up with the laser beam which is optical in nature. Each satellite system is said to have several modulators since more than one signal are modulated and transmitted at the same time. These modulators are named as subsystem-1, subsystem-2, and subsystem-3 and so on. By using some piezo-electric material laser beams are generated at the transmitter end. As laser is said to have long travelling capability, large bandwidth, straight path transmission, and interference avoidance etc. it may be used as carrier for wireless communication. Optical outputs are passed through circulator. This circulator may act as router. Telescope is used in our system where multiplexing of signal takes place. Circulator and telescope may present both at transmitting and receiving end [5].

B. Optical Wireless Channel

This channel may allow the signal to pass through. Through this channel optical signal may be transmitted with laser beam as carrier source.

C. Receiver

Transmitted signals are received by receiver through telescope. Demultiplexing is done as soon as the receiver receives the transmitted signal. Optical preamplifier amplifies the signal by detecting and correcting error. Then the filter filters the signal and allows the filtered signal to pass through the detector. Then the detector separates the original signal from the laser source and converts optical signal to the electrical form. Trans-Impedance Amplifier allows the signal to pass through with amplification and without modification in the bandwidth. It also converts current to a voltage source. Decision circuit makes decision about whether the signal has to transmit to other satellite or not.

D. Tracking, Pointing System

Tracking, pointing system provides the information about the location of receiver satellite. When discussing about this system it is important to know about the elevation and azimuth angles. Azimuth angles are already calculated angles which may be installed in the satellite system where as elevation angles are the values which may be calculated in the path of receiver satellite. As transmitter and receiver

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satellites are travelling around its path continuously, by comparing azimuth and elevation angles, delay in the system may be found out. Tracking and pointing system also holds the information about the transmitted output which may be utilized for further processing.

III. Block Diagram Of Our System

The block diagram of our system is shown in the figure 1. In satellite applications it is important to reduce the size and weight of the communication terminal which is achieved by replacing transmitting and receiving antenna through single telescope. Every satellite system is said to have both transmitter and receiver section. During communication, transmitter section of one satellite and receiver section of other satellite are said to be in activation condition. The modulated signals from several channels are accompanied through a single telescope at the transmitter end which is said to be a multiplexing process. Then the multiplexed signals travel along free space with laser as carrier beam. Demultiplexing is done at the receiver part where through on-off keying all the signals are separated.

The signals are stored in the form of current. That means satellite hold the information in electrical form. But during transmission electrical signals are converted to optical form. Thus electrical to optical and optical to electrical conversion takes place in this communication system. Laser beams are capable of propagating long straight distance and hence it is very much suited for satellite communication.

IV. Methodology For Preamplifier Section

Methodologies for preamplifier are the simple steps used to show the performance of optical preamplifier. As soon as the receiver receives the signal it should reduce the noise by matching the sample signal with the original signal that might have been received. If any mismatch occurs in large amount then the receiver system may request transmitter for retransmission. Even though for small amount of losses, the receiver should detects the particular error and correct it. For this purpose error detection and correction codes should be used. All these operations are performed by optical preamplifier. Its logic diagram is shown in figure 2.

Initially the input signal is received from the transmitter end of the satellite system. This is said to be the initialization process. The received input signal may be audio or video. For audio signal single band is required for transmission and for video signal two bands are required. Much more problems are not created by audio signals when transmitted between two satellites. But for video signal it is not so. Hence for our analysis of noise removal we have chosen audio signal. Next step is to identify noise in the signal. If any error occurred it may be identified by using error detection codes. Then it is corrected by using correction codes. This is done by comparing the sample signal with the received signal. Then the corrected signal is allowed for signal to noise ratio detection. Then in further steps signal strength have been increased. Then the simulation results are analyzed and the appropriate graphs are obtained followed by obtaining the desired amplified output.

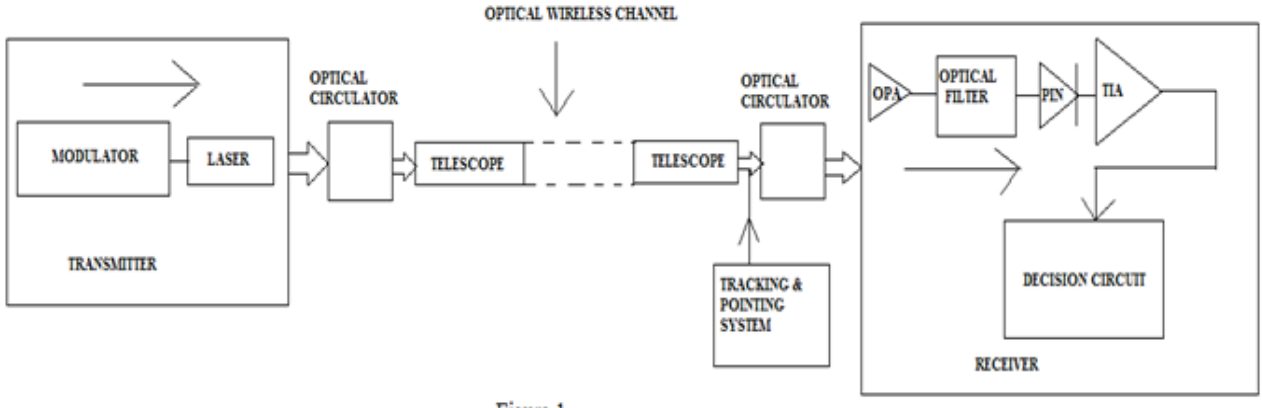

Figure 1

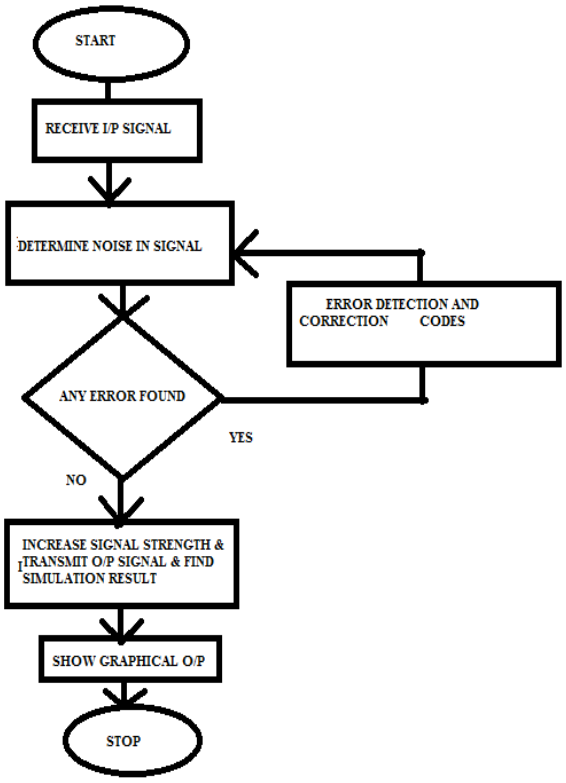

Figure 2

V.OUTPUT EVALUATION

A. *Noise analysis*

Since several signals are passed at the same time a signal is taken into account and then it is divided into two signals and then these signals are passed through separate channels in the input terminal. While transmitting through wireless channel some losses may occur due to some delay or distortion and this may be identified as noise in the signal. The simulation results obtained in figure 3 may deals about how much of noise added after transmitting through wireless and how it is minimized after the use of preamplifier. Here two signals are differentiated in terms of channel named as I-channel, Q-channel components. Unfiltered and filtered form of outputs also shown. An output phase deviation provides us the information about the overall deviations in the received signal when compared with the transmitted signal. Output phase deviations are represented in parameters of radians and time. All other outputs are represented in terms of amplitude and time.

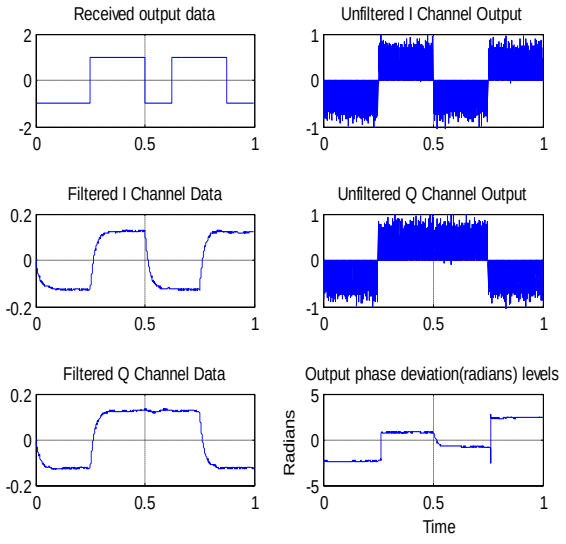

Figure 3

The noises added in two signals are combined and overall noise calculation performed is shown in figure 4. After completing the overall process the outputs obtained are also shown in the figure 4.

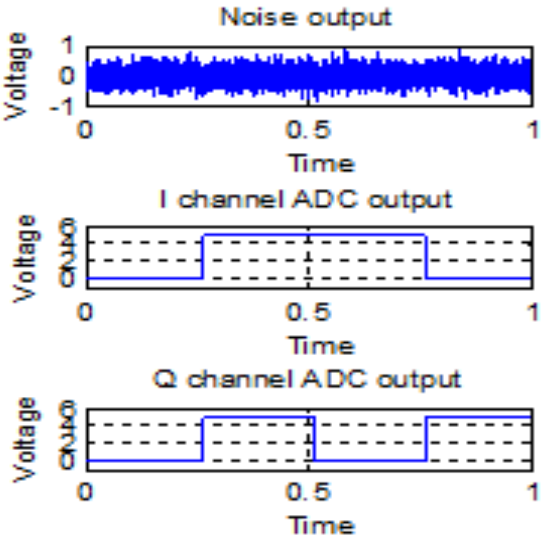

Figure 4

B. *Bit Error Rate Analysis*

The simulation result shown in figure 5 provides the information about the Bit Error Rate. As the main theme of this report is to reduce the noise in the signal this result plays a vital role in it. It is shown in figure 5. It may also be noted that as the Signal to Noise ratio increases Bit Error Rate decreases.

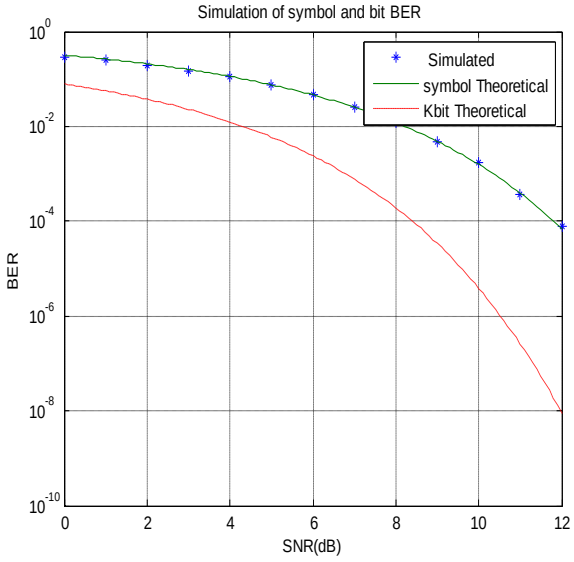

Figure 5

V. CONCLUSION

Although preamplifier have been used in several level of science environment, introduction of it in intersatellite communication is found to be very important as speed of transmission and error reduction is considered to be a major requirement. Satellites have been used in many sorts of communication and hence it should carry the advantage of less noise reduction.

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