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Analog and Digital Single Processing

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Abstract—*This paper represent the overview of Analog and Digital single processing. In this paper, key aspects associated with Analog and Digital single Processing and how the single has been use to transfer the data from one computer to another using internet. Data store in a computer are in the form of 0s and 1s.to be carries from one place to another (inside or outside the computer), data are usually converted to digital single. Many critical questions are answered in this paper. Like What are the Difference between Analog and Digital Single. What are the Properties of Analog Single? Why need to use Encoding and Modulation for Analog and Digital single processing? How the Information has been translated into single before transformed across communication media and how information is transformed depend on its original format and on the format used by the Communication hardware.*

A simple single by itself does not carry information any more than a straight line conveys word. The single must be manipulated so that it contains identifiable changes that are recognizable to the sender and receiver as representing the information intended. Firstly the information must be translated into agreed-upon patterns of 0s and 1s. This paper also represents the Method or Technique which has been use for Digital to Digital Conversion, Analog to Digital Conversion, Analog to Analog Conversion, Digital Conversion, Digital to Analog Conversion, Analog to Digital Conversion, Analog to Analog Conversion and Digital VS Analog single processing and Application of Digital and Analog Single.

1. INTRODUCTION

The most important part of any Analog and Digital Processing task is understanding how information is contained in the signals you are working with. There are many ways that the information can be contained in a signal. Actually, This is especially true if the signal is manmade. For instance, consider all the modulation schemes that have been devised: AM, FM, single-sideband, pulse-width modulation, pulse-code modulation etc. Whether, The list goes on and on. There are only two ways that are common for information to be represented in naturally occurring signals. The information represented in the time domain, and information represented in the frequency domain.

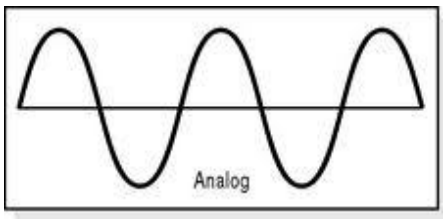
Information represented in the time domain describes that when something occurs and what the amplitude of the occurrence is. For example, we assume an experiment to study the light output from the sun. Additionally, The light output is measured and recorded once each second. Each sample in the signal indicates what is happening at that instant and level of the event. If a solar flare occurs, then the signal directly provides information on the time it occurred, the duration, the development over time, etc. Each sample contains the information which is interpretable without reference to any other sample. Even if you have only one sample from this particular signal, you still know something about what you are measuring. This is the simplest way for information to contained in a signal.

2. WHAT IS SIGNAL

A signal is a detectable or measurable physical quantity containing some kind of information that **can** be recorded, displayed, or manipulated. Examples of singles include temperature, pressure, sound, wave, such as speech and music.

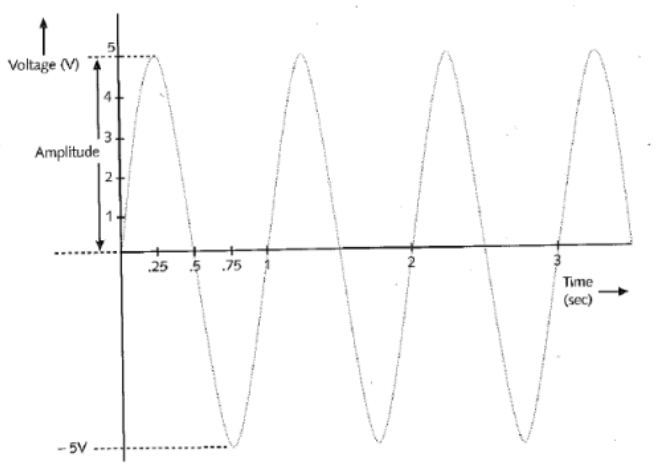
3. ANALOG SIGNAL

Analog refers to something that is continuous. Additionally, An example of analog data is the human voice. When someone speaks, a continuous wave is created in the air. These all activities can be captured by a microphone and converted to an analog signal. An analog signal is a continuous wave form that changes smoothly over time to time. As he wave moves from value A to value B, It passes through and includes an infinite number of values analog its path.



Simple Analog signal

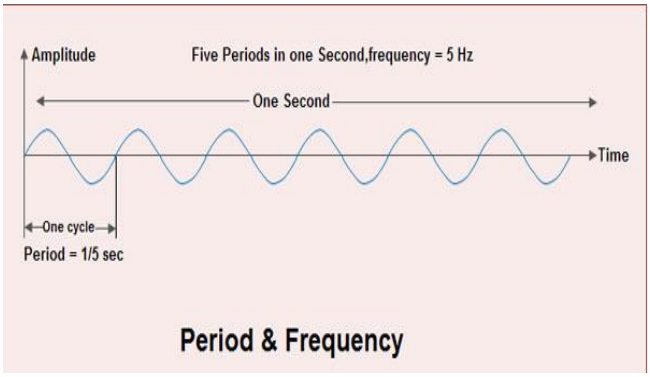
- **Amplitude:** Refer to the height of the signal. The unit for Amplitude depends on the type of the signal. For electrical signals, the unite is normally volts, Amperes, or watts. Volts refer to voltage, amperes refer to current and watts refer to power.



Amplitude of Analog signal

- **Period and Frequency:** Period refers to the amount of the time in second, a signal needs to complete one cycle.

Frequency refers to the total number of periods in one second. However, The Frequency of a signal is its number of cycles per second.



- **Unit of Period:** Period is expressed in seconds, so The communications industry uses five unit to measure period; **second** (s), **millisecond (ms=10^{-3} s), microsecond (**μs=10^{-6} s), **nanosecond (**ns=10^{-9} s), and **picoseconds (**ps=10^{-12} s).
- **Phase:** Phase is measured in degree or radians(360 degree is 2π radians).A phase shift of 360 degrees corresponds to a shift of a complete period; a phase shift of 180 degrees corresponds to shift of half a period; and a phase shift of 90 degree corresponds to a shift of a quarter of a period.
- **Bandwidth:** Bandwidth refers to the range of component frequency, and frequency spectrum refers to the elements within that range. To calculate the Bandwidth, we have to subtract the lowest frequency from the highest frequency of the range. However, The frequency spectrum of a signal is the combination of all sine wave signals that make up that signal.

4. DIGITAL SIGNAL

A digital refers to something that is discrete-a set of specific point of data with no other points in between. It can have only a limited number of defined values, often simple as 1 and 0.A digital signal is represented by the presence of voltage or absence of voltage.

Digital Signal

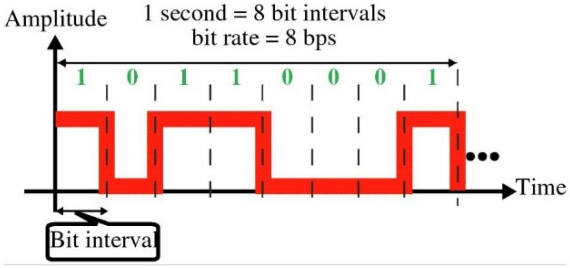
In Digital signals, 1 represented by having a positive voltage and Zero is represented by having no voltage or Zero voltage. Each signal is unique from the previous digital value and unique from one to come. A digital signal is a snapshot of a condition and does not represent continual movement. Digital signals have basically two values. It is easier to work with two values rather than an infinite number. Our current level of technology allows us to maintain the original quality of a digital signal. With a value of "on" or "off", it's pretty hard to miss.

Bit Interval and Bit rate

Bit interval is the time required to send one single bit.

Bit rate is the number of bit intervals per second.

This means that the bit rate is the number of bits sent in one second, usually expressed in bits per second(bps).



Bit rate and Bit Interval

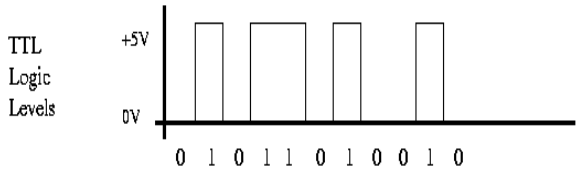
5. LINE CODING/ENCODING

Encoding only converted binary data into digital signal. Separated processes are used to convert this signal to analog if the communication channel is analog in nature. Process of converting binary data into a digital signal is known as Encoding.

6. TYPES OF ENCODING

1. Unipolar Encoding

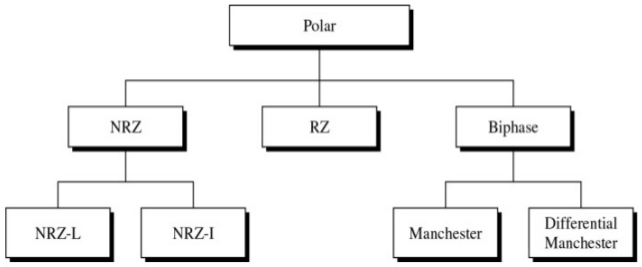
Unipolar line Encoding uses two voltage stages to represent data. Actually, One of these voltage stages is always Zero. In this Line coding Scheme, 1s are encoded as positive values and 0s are encoded as 0 value.



Uni-polar encoding works well for signals that are produced to travel short distances within the computer system but they are not suitable for the signal that have to travel across a communication channel to a far place.

2. Polar Encoding

The polar encoding uses two different uses two different voltage levels to represent difference in the signal.It uses a positive voltage to represent a binary 1 and a negative voltage to represent 0 in a signal. Two different voltage levels are used to reduce the average voltage level on the line. However, Polar encoding has an added benefit in that it reduces the power required to transmit the signal by one-half compared with unipolar. Some of the well known polar encoding are:



1. NRZ (Non Return to Zero): In NRZ encoding, the level of signals are always either positive or negative.

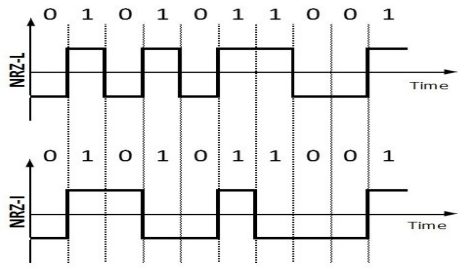
NRZ has two main methods called NRZ-L and

NRZ-I.

(a) NRZ-L:-in NRZ-L encoding 0 use for represent positive signal and 1 use for represent negative signal.

(b) NRZ-I:-in NRZ-I encoding 1 is encountered in the bit stream. This means the transformation of signal is done only when 1 is to be represented. The Signal is simply inverted when 1 is encountered.

For Example:

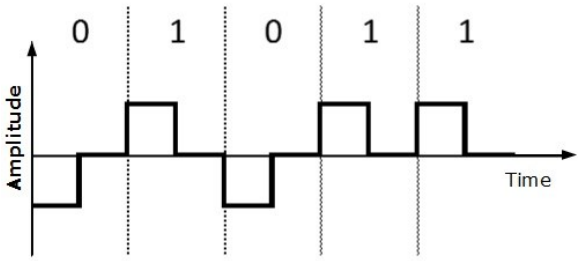


NRZ-L and NRZ-R Encoding

Return to Zero: In RZ use three values positive, negative and Zero to represent the signal.

In which positive voltage is represented by 1 and negative represent by Zero but the signal return to zero halfway through each interval.

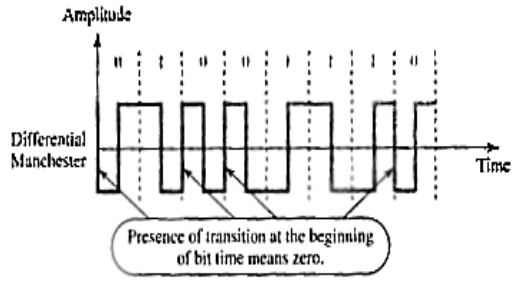
So 0 is represented by negative to zero and 1 is represented by 1 to 0 in each bit.

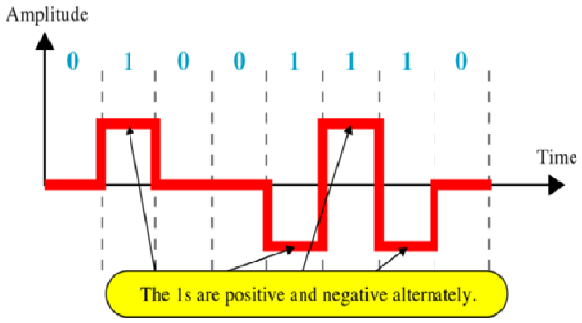


3. **Biphase Encoding:** biphase encoding is the best possible solution to Synchronization problem.In biphase the signal is change at the middle of bit bit interval and does not return to Zero.

Type of biphase

1) **Manchester encoding:** Manchester encoding uses the inversion at the middle of each bit interval for both represented and Synchronization .the following figure illustrates the Manchester encoding.
2) **Differential Manchester encoding:** In differential Manchester encoding, the signal is inverted when 0 is encountered. The transition is occurs on the presence of 0 and there is no change for binary 1 in the signal. The following figure represents differential Manchester Encoding.
3) **Bipolar:-**bipolar also use three voltage lever to represent bit into signal. A binary Zero is represented by Zero and binary 1 represented by alternating positive and negative voltage and the second 1 is represented by a negative voltage. The following figure represents Bipolar Encoding





7. MODULATION

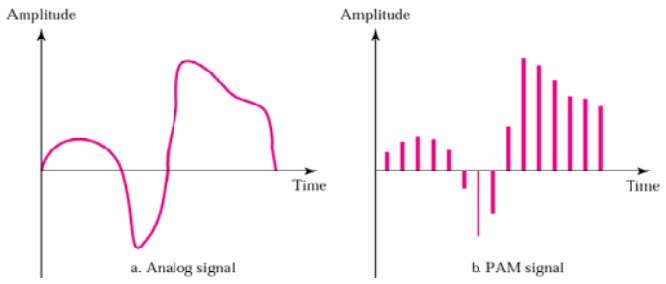
Modulation is a technique which is also use for analog and digital signal processing. Modulation use for converting digital signal to analog signal and demodulation use for converting analog signal back into digital signal. This paper described the modulation technique or we can say analog and digital signal processing technique.

1) Analog to Digital Conversion

We sometime need to digitize an analog signal. For example, to send human voices over a long distance, we need to digitize it since digital signal are less prone to noise. This is called an analog to digital conversion. Several methods for analog to digital conversion will be discussed later in this paper. Following are some the mainly used modulation technique:

1. PAM

This technique takes an analog signal, sample it, and generated a series of pulses based on the result of the sampling. The term sampling means measuring the amplitude of signal at equal intervals. In PAM, the original signal is sampled at equal intervals as show in figure.

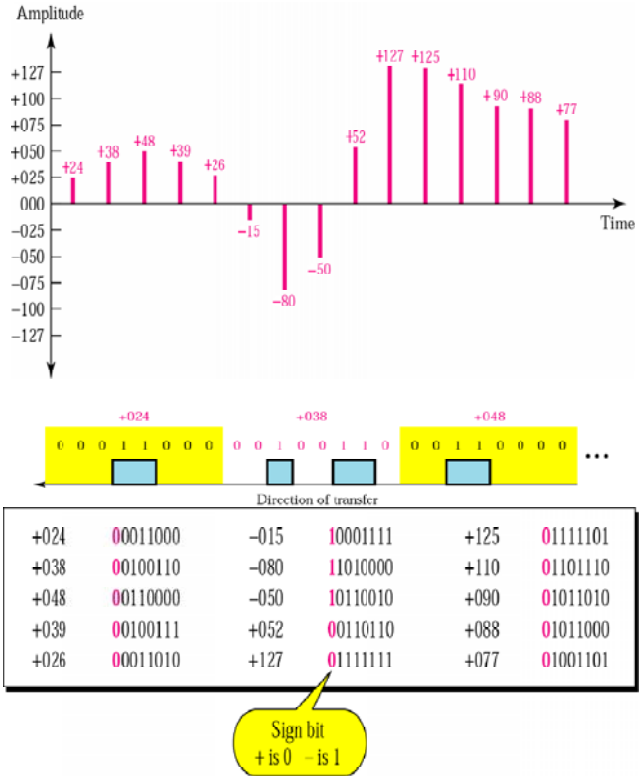


Pulse amplitude modulation has some applications, but it's not used by itself in data communication. It is the first step in another very popular conversion method called pulse code.

2. PCM

PCM modifies the pulses which created by PAM to create a completely digital signal. PCM quantized the PAM pulses (assigns integer values in a specific range to

Sampled instances.



According to the Nyquist theorem, Sampling rate must be at least 2 times the highest frequency.

1. What sampling rate is needed for signal with a bandwidth of 10,000 Hz (1000 to 11,000 Hz)? The sampling rate must be twice the highest frequency in signal:

Sampling rate = 2 x (11,000) = 22,000 samples/s

2. We want to digitize the human voices. What is bit rate, assuming 8 bits per sample?

The human voice normally contains the frequencies from 0 to 4000 Hz.

Sampling rate = 4000 x 2 = 8000 samples/s

Bit rate = sampling rate x number of bits per sample

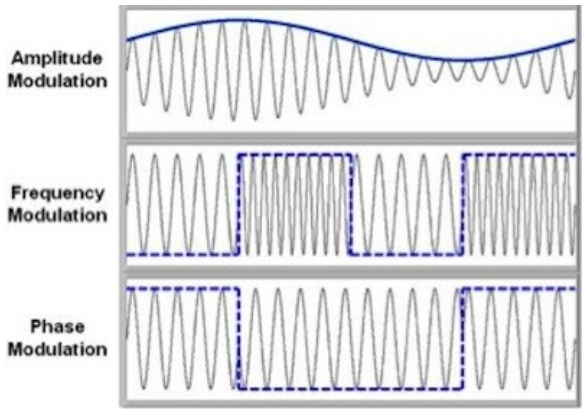
= 8000 x 8 = 64,000 bps = 64 Kbps

Note that we can always change a band-pass signal to a low-pass signal before sampling. In this case, the sampling rate twice the bandwidth.

2) Digital to analog conversion

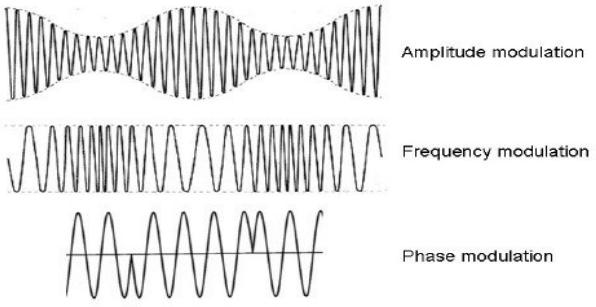
Digital to analog conversion is needed when the source of the signal is digital but the carries of the signal is analog. The best example of the type of modulation is when you connect to the internet. There are three main methods to convert digital signal to analog signal there are.

a. **Amplitude shift keying(ASK):** in which frequency and phase of the signal remain constant while the amplitude change.
b. **Frequency Shift keying:** in which the Amplitude and phase remain constant but the frequency of the signal is changed.
c. **Phase Shift keying:** in which Amplitude and Frequency remain constant but the phase of signal is changed.



3) Analog to Analog Conversion

Analog to analog conversion is needed, when some analog information is to be carried on in the form of analog signal. for example, the radio station convert voice signals into radio wave and these wave travel up to the antenna of your radio and radio give out the sound. Both sound signal and radio wave are analog in nature. Three main modulation technique are used for Analog to Analog conversion. These are:



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9. CONCLUSION

The Conclusion of this paper is to derive all the phases of Analog and Digital signals Processing. We discussed Analog Signal, Digital Signal, types of Encoding and Modulation etc. Various Conversions like Analog to Digital And Digital to Analog signals is determined. However, Signals processing techniques and methods are considered.

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