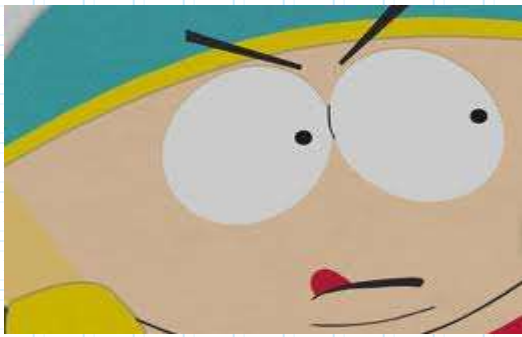# Analog Data Digital signal

Some time there is need of representing analog data in terms of Digital signals. These digitals signals can be transmitted later on using Line Coding

But why do we need to convert Analog data in to digital signals. Isn't it true that analog signal can cover a larger range?

Yes that is very much true, Normally the data available to us is in form of analog signal. However analog signal is sensitive to noise, especially over long distance and cannot be perfectly reconstructed

Solution:

(1) digitize the analog signal at the sender

(2) transmit digital signal

(3) convert digital signal back to analog data at the receiver

Some of the Methods used for this purpose are as follow

- · Pulse Code Modulation
- · Pulse Delta Modulation

Advantages of Using Digital Signals

- Use of repeaters, instead of amplifiers, implying no additive noise.
- Use of time-division multiplexing, instead of frequency-division multiplexing
- Availability of efficient digital switching techniques.
- Development of more efficient coding techniques.

PULSE CODE MODULATION

A simple procedure is followed in this method. An Analog signal is sample in to PAM, and is than quantized   to get digital signals
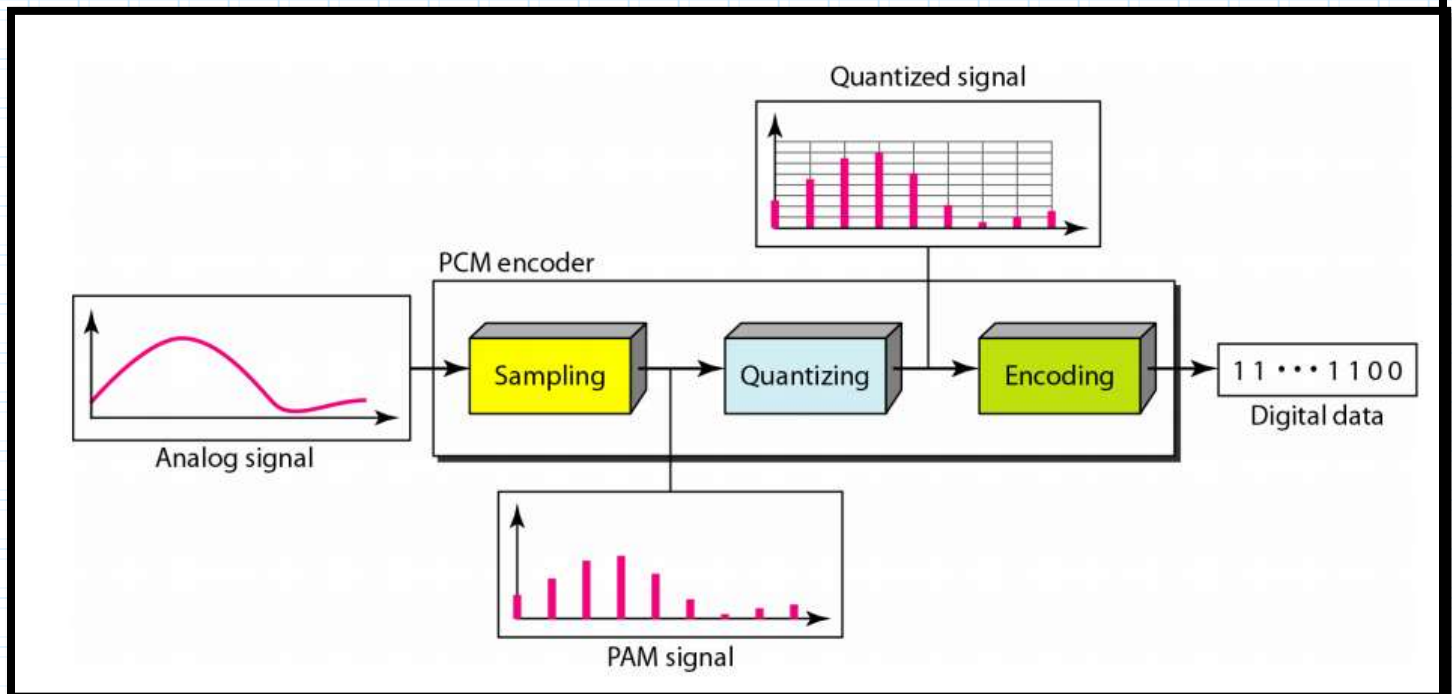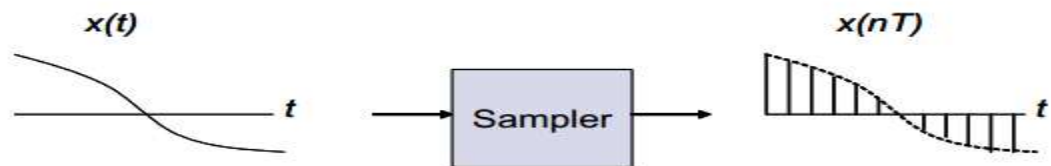
1) Analog Input

An signal is provided at input and is converted to analog signal e.g A audio signal is converted to Analog data , using a transducer

2) Sampling

In second phase this input signal is sampled. The sampling process results in signal that is discrete in time but analog in amplitude!

3) Quantization

Encoding the amplitudes for PAM would require infnte number of bits . So instead each sample has to be 'rounded up' to the nearest of M possible quantization levels:(

Limitations

• M↑ ⇒ better precision ☺, more bits per sample ☹

• M↓ ⇒ poor precision ☹ fewer bits per sample ☺

Quantization Error : During this process , there is a large possibility that , due to the selected number of quantization

level, analog data is not translated perfectly to Digital signal, hence causing error. Higher the number of Quantization level is used, higher is SNR ,and also the minimum is the quantization error
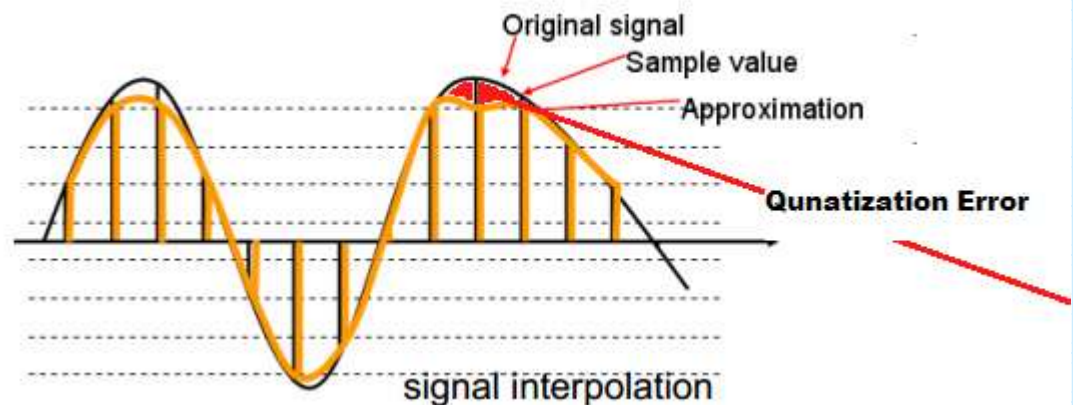
4) Encoding
The data is than encoded and is tranmistted using any suitable line coding method

Advantages of PCM

Noise - The PCM signal is a digital waveform. Digital waveforms are less susceptible to interference and noise than analog signals

Repeatability- A PCM signal can be received by a repeater device that decodes the data and retransmits it. This allows PCM signals to be sent very long distances without data corruption.

Storage- A PCM waveform may be saved for later recreation or playback. Since PCM data is digital in origin, it can be stored using a computer or similar device.

Security- A PCM signal can be modulated in such a way that only a specific decoder can make sense of the underlying data. This is useful when the data being sent requires a level of security.

Disadvantages

1) The encoding, decoding and quantizing circuitry of PCM (Pulse Code Modulation) is Complex.

2) Pulse Code Modulation requires a large Band width as compared to the other systems

Applications

In telephony PCM is used to Digitize the Analog Voice(or speech).

In Space communication, space craft transmits signals to earth. Here ,the transmitted power is very low i.e 10 to 15 w and the distances are huge (a few million km).Still due to the high noise immunity, only PCM Systems can be used in such applications.

PULSE DELTA MODULATION

DM modulator — Analog signal → Comparator → Digital data (11···1100); Delay unit, Staircase maker
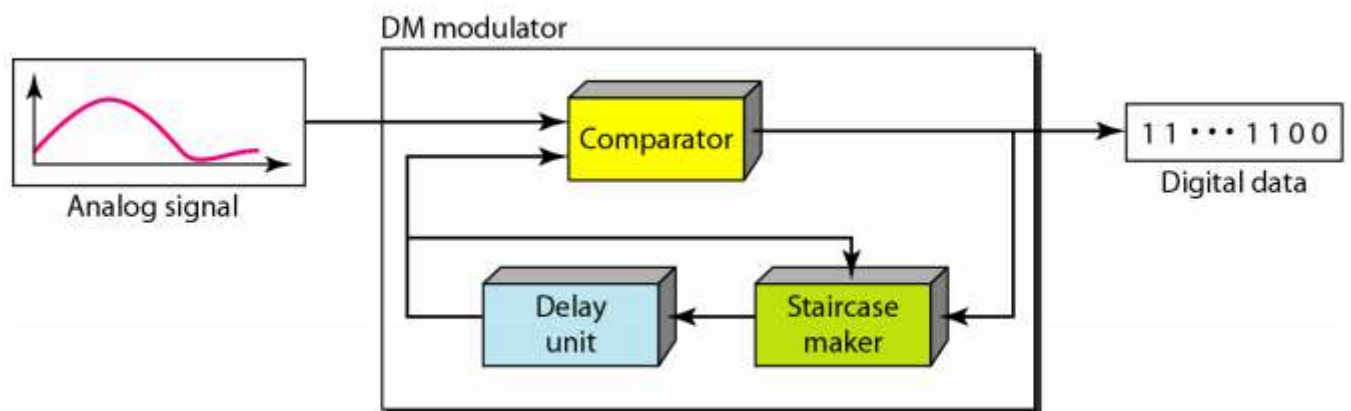
- Delta modulation (DM or Δ-modulation)is an analog-to- conversion technique used for transmission of voice information where quality is not of primary importance.

Characteristics OF Delta Modulation

- In delta modulation, the transmitted data is reduced to a 1-bit data stream.
- Transmits information only to indicate whether the analog signal that is being encoded goes up or goes down
- The Encoder Outputs are highs or lows that "instruct" whether to go up or down, respectively
- The output modulation signal represents upward stair by 1 and downward stair by 0.
- DM takes advantage of the fact that voice signals do not change abruptly
  - DM provides a staircase approximation to the oversampled version of the message signal
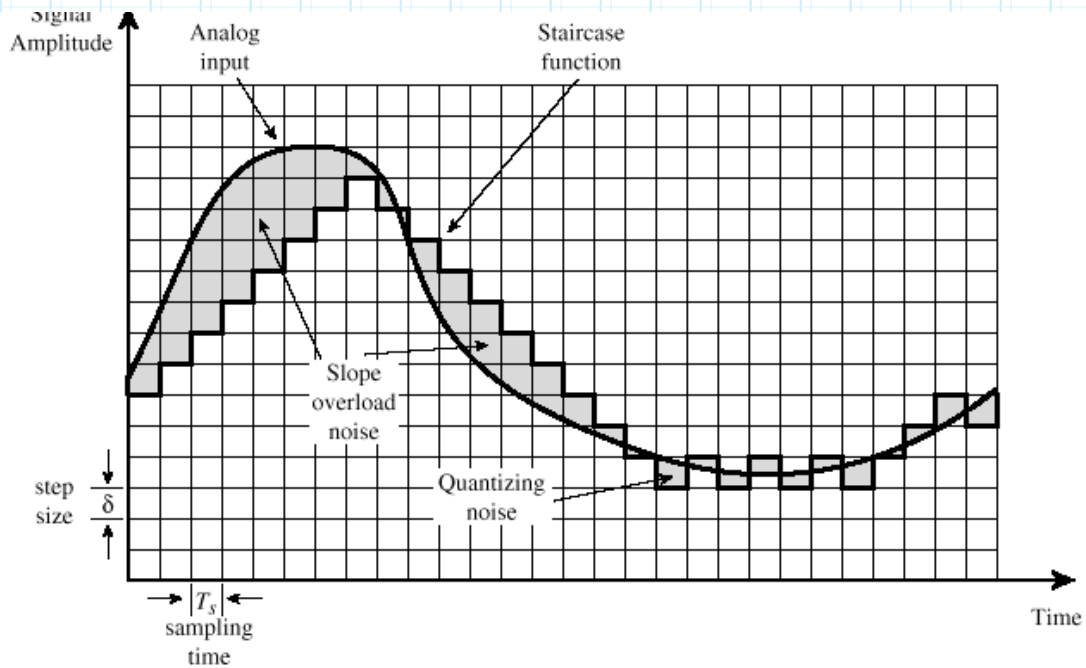
The receiver may use smoothing algorithm when reconstructing the input signal.

Finer division on time slot provides better approximation with the cost of extra data

Limitations

The PDM scheme can only be used to estimate data, which does not change rapidly m
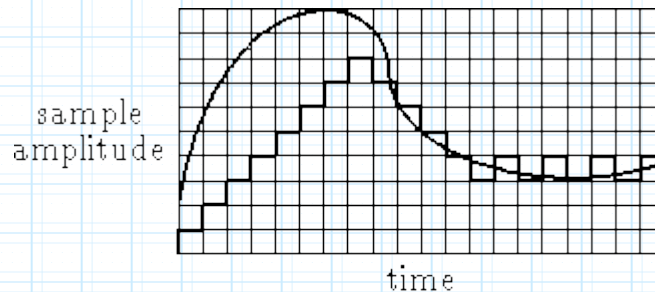
Advantages :

Simple and Easy as compared to PCM

Requires less bandwidth as compared to PCM

Disadvantages

 DM is easier than PCM to implement, but it exhibits worse signal to noise ratio for the same data rate.