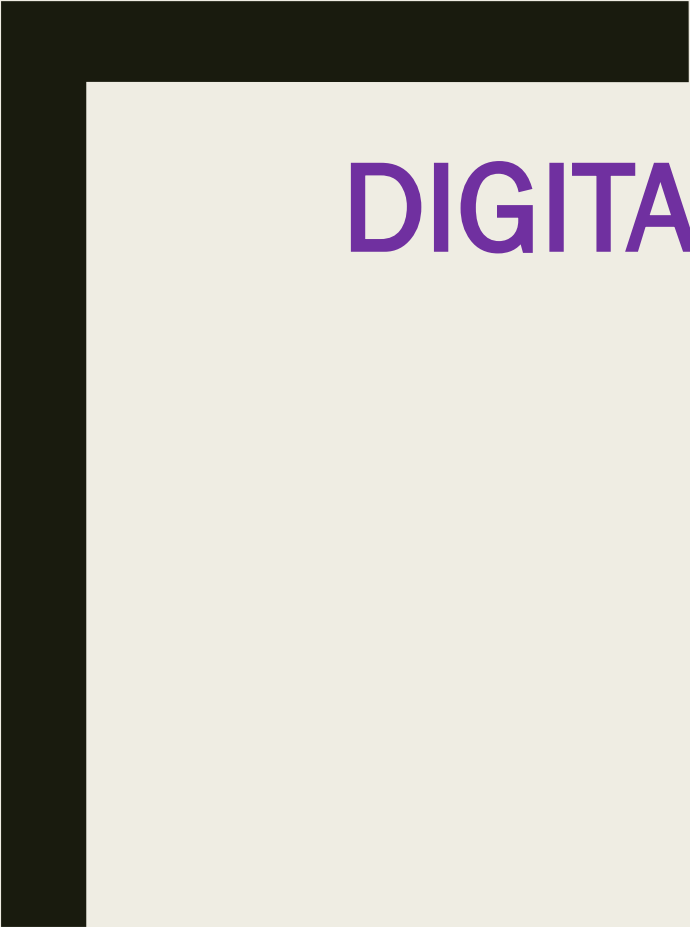




DIGITAL PULSE MODULATION TECHNIQUES

Review



General notes

- ❖ They are convert analog signal to digital (binary, 0.1) and make it suitable for modern digital communication systems.
- ❖ Because of this conversion, some noise (error) is permanently introduced in the result signal.
- ❖ This is because the analog to digital conversion is not ideal and perfect(there is some approximations)
- ❖ The main problems associated with Digital pulse Modulation techniques is that they need large channel Bandwidth.
- ❖ To reduce the Bandwidth, the number of bits required to represent samples of signal must be reduced.
- ❖ But if this happens, noise increase.
- ❖ A compromising between Bandwidth and noise is required in real applications.

I. Pulse Code Modulation(PCM)

- The first type of Digital Pulse modulation techniques is **Pulse Code Modulation PCM**
- In this type(**PCM**),
 - The signal is sampled at F_s (**$F_s \geq 2F_m$**) ,
 - Quantized by comparison with (**q**) predefined levels
 - Encoded to **v** bits per each q level
 - These process leads to a noise or error called quantization error (ϵ)
 - it has maximum value $(\epsilon_{max}) = |\frac{\delta}{2}|$
 - It has bit rate, **$r = v.F_s$** bit per second
 - It has bandwidth, **$BT=1/2(V.F_s)$**

Continue

- ❑ In PCM, the error or noise is related to signal by **Signal power/Noise power**
- ❑ The **general equation** for this ratio is,

maximum signal to quantization noise ratio:= $\frac{S}{N} = \frac{3P}{(X_{max})^2} \cdot 2^{2v}$

- ❑ **Signal to quantization noise** ratio for **normalized values** of power and amplitude of input signal

$$\left(\frac{S}{N} \right) \text{ dB} \leq (4.8 + 6v) \text{ dB}$$

- ❑ **Signal to quantization noise** for **sinusoidal input** signal is,

$$\left(\frac{S}{N} \right) \text{ dB} \leq (1.8 + 6v) \text{ dB}$$

II. Delta Modulation(DM)

- We have seen in PCM that, it transmits **all the bits** which are used to code the sample.
- Hence signaling rate and transmission channel Bandwidth are large
- To overcome this problem Delta Modulation is used.
- Delta modulation transmits only one bit per sample.
- In DM, the present sample value is compared with previous sample value and according to this comparison, **“1”** is transmits if the difference is positive(present sample is grate the previous) and **“0”** is transmits if the difference is negative (present sample is less than the previous)
- That means **only one bit** is transmit for each sample.

Advantages of DM(compare with PCM)

1. Delta modulation transmits only one bit for each sample. thus signaling rate and transmission bandwidth is quite small.
2. The transmitter and receiver implementation is very much simple

Disadvantages of DM

- I. Slope overload distortion(startup error): this arises because of large dynamic range of the input signal (the input signal is more steep) i.e. has high slope.

To reduce this error, the step size should be increased when slope of input signal is high.

- II. Granular Noise (Hunting) : it occurs when the input signal varying slowly (low input signal slope)

To reduce this error, the step size should be reduced when slope of input signal is low.

- III. Thus large step size is required to accommodate wide dynamic range of the input signal (to reduce slope overload distortion) and small steps. are required to reduce granular noise

- IV. **Adaptive Delta Modulation is the modulation to overcome these errors.**

III. Adaptive Delta Modulation (ADM)

- ❖ To overcome the quantization errors due to slope overload and granular noise, the step size (δ) is made adaptive to variations in the input signal.
- ❖ Practically, in the steep segment of the input signal, the step is increased. When the input is varying slowly, the step size is reduced.
- ❖ Then the method is called Adaptive Delta Modulation

ADM