FLAT TOP SAMPLING

DIGITAL COMMUNICATION & STOCHASTIC PROCESS (EC503)

SOUVIK GHOSH 13000320025
ELECTRONICS & COMMUNICATION ENGINEERING

Content

Introduction

- **Sampling theorem** states that in any pulse modulation system if the sampling rate of the samples exceeds twice the maximum signal frequency, then this ensures the reconstruction of the original signal in the receiver with minimum distortion.
- Sampling theorem can be expressed as given below:
- $f_s \geq 2f_m$

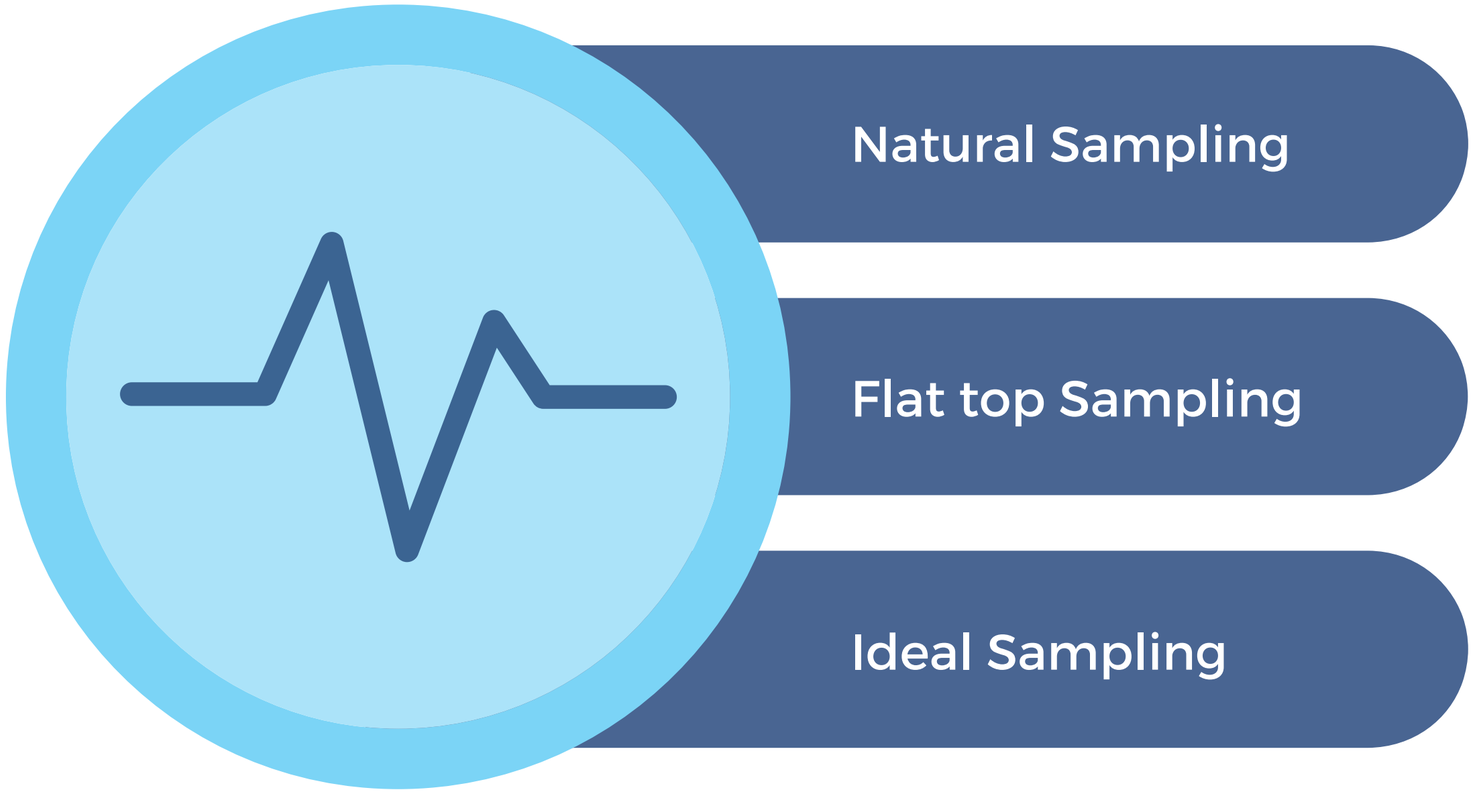
  Where,

  f_s is the sampling frequency and

  f_m is the maximum modulating signal frequency.
- **Sampling** is a process of translating a continuous analog signal into a discrete analog signal, where the sampled signal is the discrete-time representation of the original analog signal.

Sampling Techniques

There are basically three types of Sampling techniques, namely:



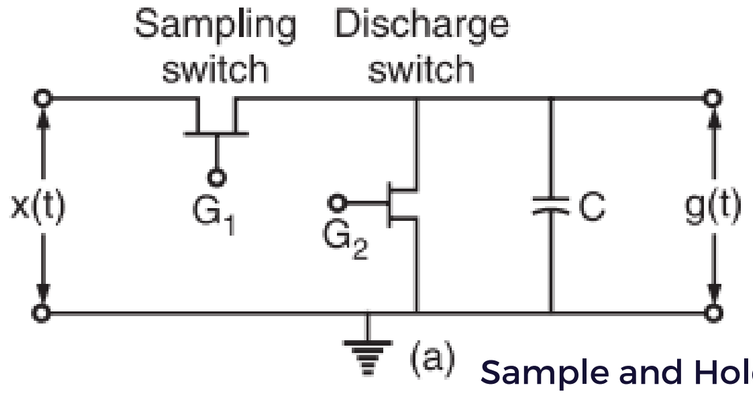
- Natural Sampling
- Flat top Sampling
- Ideal Sampling

Flat Top Sampling

- During transmission, noise is introduced at top of the transmission pulse which can be easily removed if the pulse is in the form of a flat top. Here, the top of the samples is flat i.e. they have constant amplitude. Hence, it is called flat top sampling or practical sampling.
- In flat top sampling, the top of the samples remains constant and equal to the instantaneous value of the modulating signal at the start of the sampling.
- Thus the amplitude of the pulse after sampling is kept constant and the top of the sampled pulse do not follow the contour of the modulating signal, unlike Natural sampling.
- The duration of each sample is τ and the sampling rate is $f_s=1/T_s$. $T_s=1/f_s$.

Sample & Hold Circuit

- Sample and hold circuit is used for the generation of the sampled signal to attain flat top sampling, which is shown below.

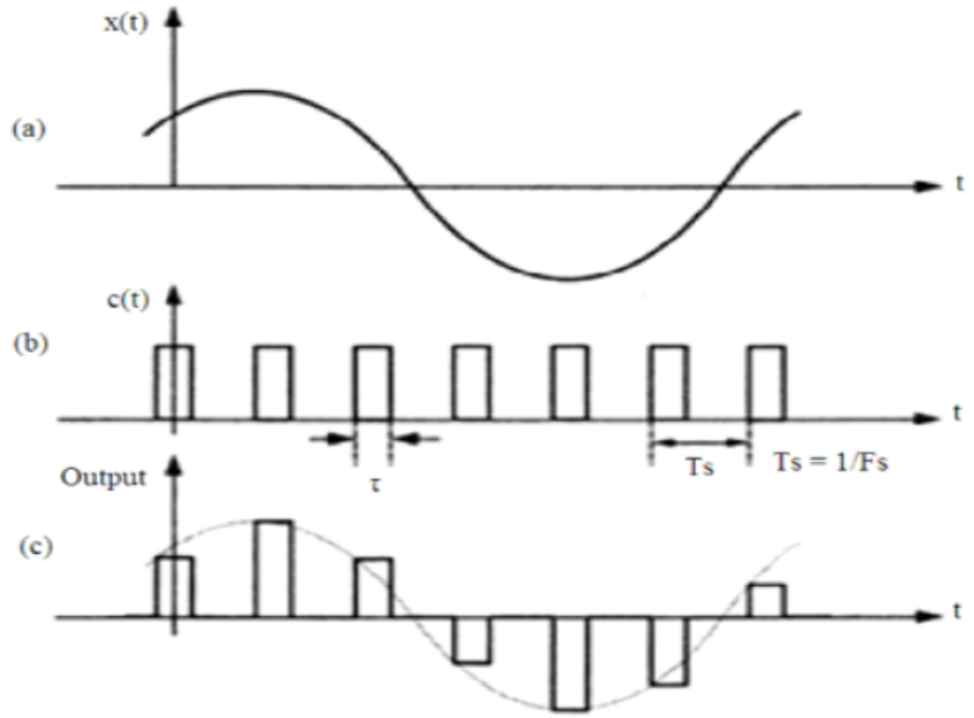


Sample and Hold Circuit

- The switch G1 closes at each sampling instant to sample the modulating signal.
- The capacitor C holds the sampled voltage for period τ at the end of which switch G2 is closed in order to discharge the capacitor.

Flat Top Sampled Signal

- The signal generated as a result of the sample and hold process is the flat top sampled signal. The spectrum of the generated flat top sampling signal along with the modulating signal and the sampling signal is shown below.



(a) Modulating signal (b) sampling signal and (c) Flat top sampling spectrum

- The starting edge of the pulse corresponds to the instantaneous value of the modulating signal x(t).
- Flat top sampling can be mathematically considered as a convolution of the sampled signal and the pulse signal.
- Flat top sampling is mostly used in digital transmission.

Aperture Effect

- The amplitude of the flat top signal must be constant, but sometimes it is not constant due to the high-frequency roll-off of the sampling signal.
- This results in attenuation in the high-frequency part of the message spectrum.
- Thus the sampled signal in the flat top sampling consists of attenuated high-frequency components and this effect is known as the **Aperture effect.**
- The aperture effect can be improved by selecting the value of pulse width τ to be very small and by using an equalizer circuit.

thank you!