Recap

Natural sampling

Topics for this session

Flat top sampling

Signal recovery – Sample and Hold circuit

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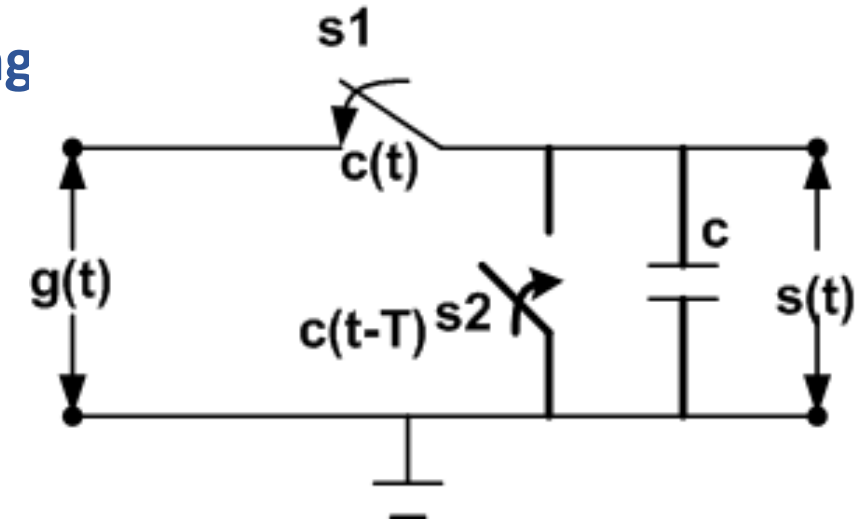
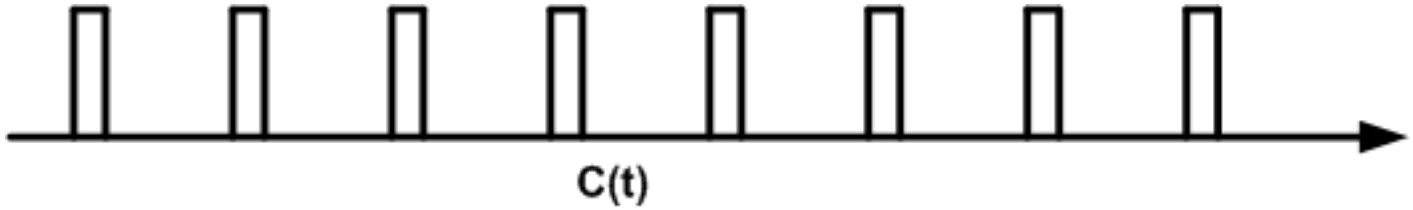
Practical aspects of sampling and signal recovery

- *Flat-top* sampling





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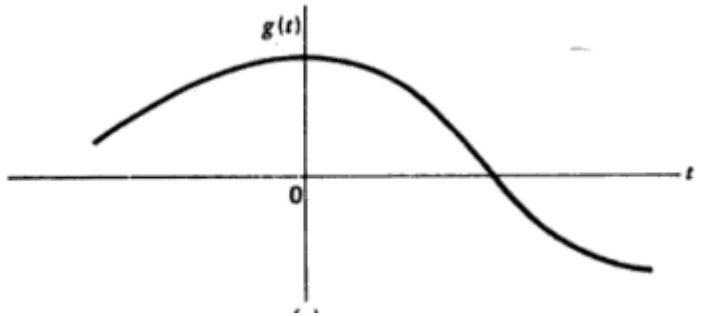
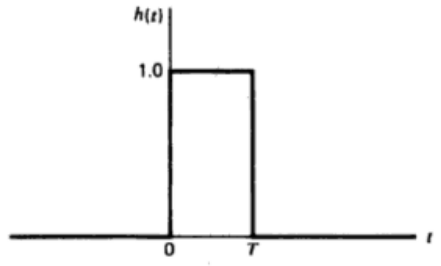
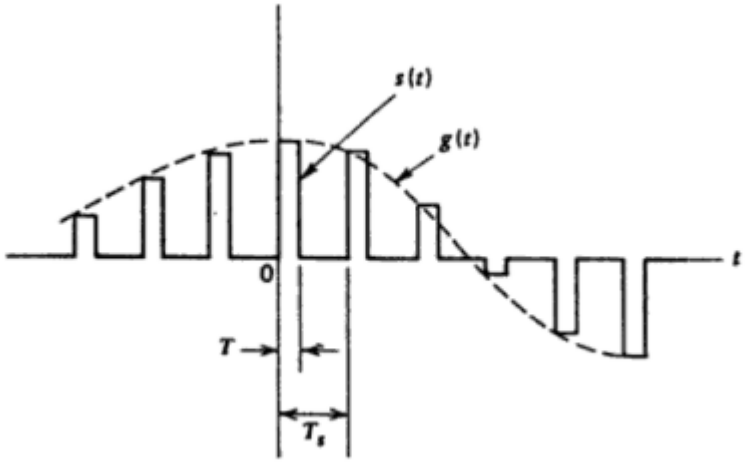
Flat-top Sampling



Analog signal



Rectangular pulse



Flat-top samples

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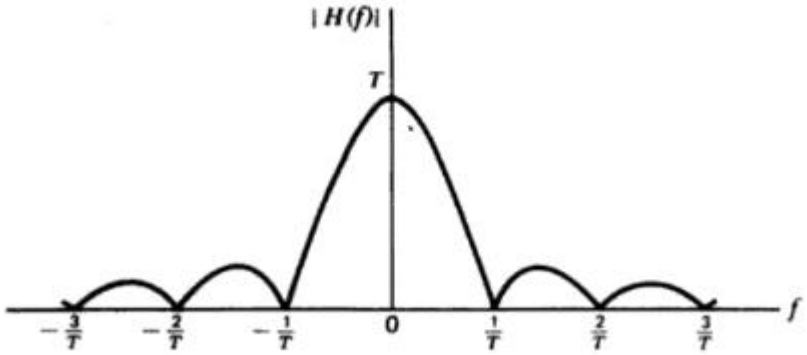
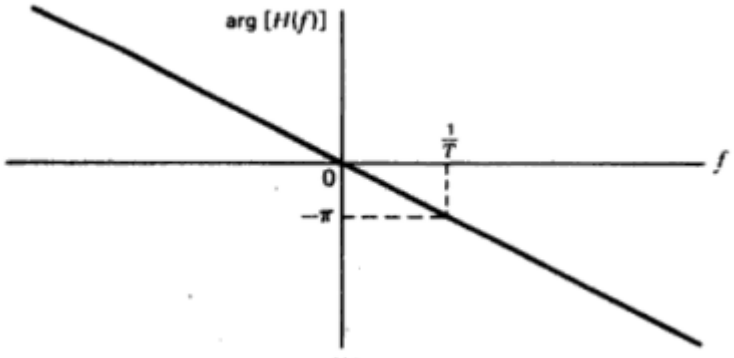
Flat-top Sampling



Magnitude spectrum of H(f)



Phase spectrum of H(f)

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Flat-top sampling

$$s(t) = \sum_{n=-\infty}^{\infty} g(nT_s)h(t - nT_s)$$

$$h(t) = rect\left(\frac{t - \frac{T}{2}}{T}\right) = rect\left(\frac{t}{T} - \frac{1}{2}\right)$$

h(t) is rectangular pulse of unit amplitude and duration T.

Flat-top sampling

$$g_\delta(t) = \sum_{n=-\infty}^{\infty} g(nT_s)\delta(t - nT_s)$$

$$s(t) = g_\delta(t) * h(t)$$

$$s(t) = \sum_{n=-\infty}^{\infty} g(nT_s)h(t - nT_s)$$

Fourier Transform of s(t)

$$S(f) = G_\delta(f)H(f)$$

$$S(f) = f_s \sum_{m=-\infty}^{\infty} G(f - mf_s)H(f)$$

Flat-top sampling

Fourier Transform of h(t)

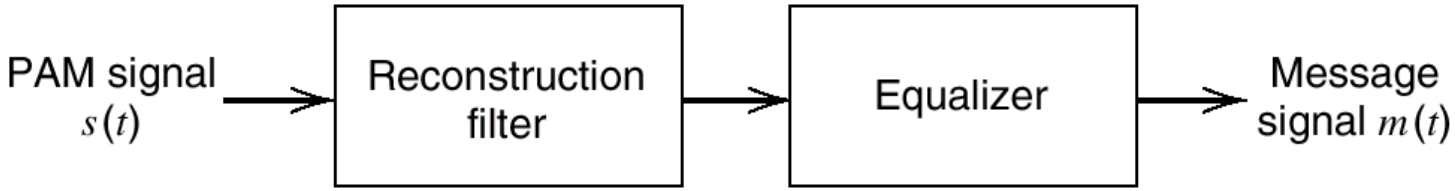
$$H(f) = T \sin c(fT) \exp(-j\pi fT)$$

amplitude distortion delay $= T/2$

Aperture effect

Amplitude response of equalizer is

$$\frac{1}{|H(f)|} = \frac{1}{T \sin c(fT)} = \frac{1}{T} \frac{\pi fT}{\sin(\pi fT)}$$



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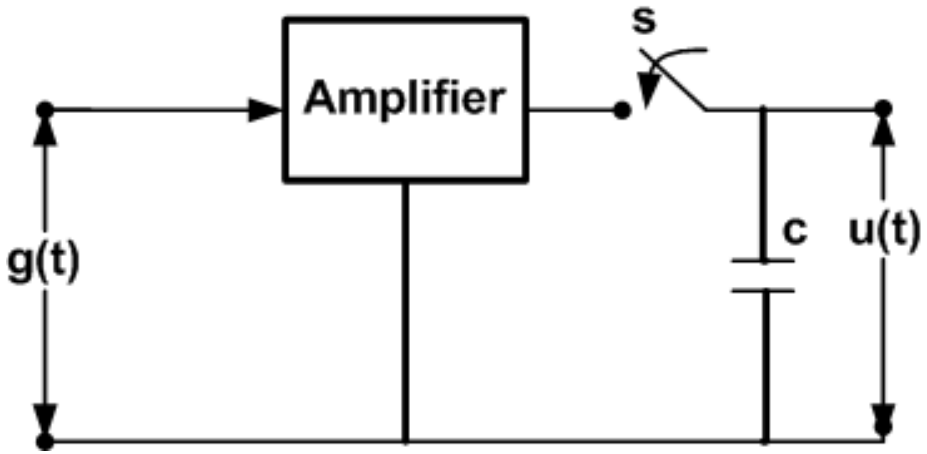
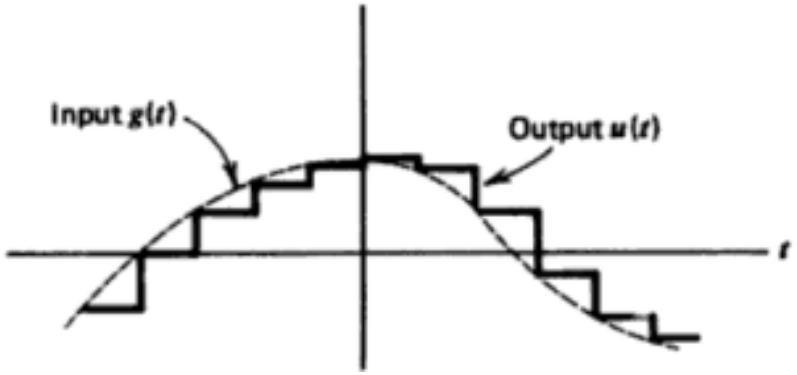
Sample and Hold circuit





Idealized output waveform

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Sample and Hold circuit

Output of sample and hold circuit u(t)

$$u(t) = \sum_{n=-\infty}^{\infty} g(nT_s)h(t - nT_s)$$

$$h(t) = \{1; 0 \le t \le T_s$$

$$= \{0; otherwise$$

Spectrum of h(t)

$$H(f) = T_s \sin c(fT_s) \exp(-j\pi fT_s)$$

Sample and Hold circuit

Fourier transform of output u(t)

$$U(f) = f_s \sum_{m=-\infty}^{\infty} H(f)G(f - mf_s)$$