Anti-aliasing Prefilter (6B)

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Please send corrections (or suggestions) to youngwlim@hotmail.com.

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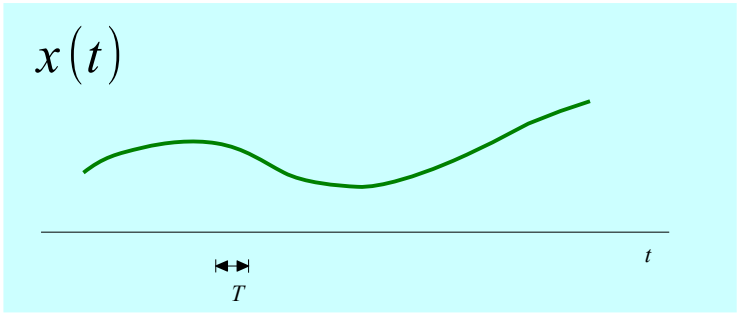
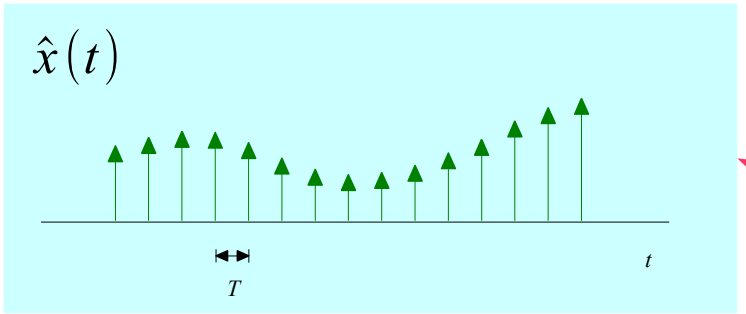
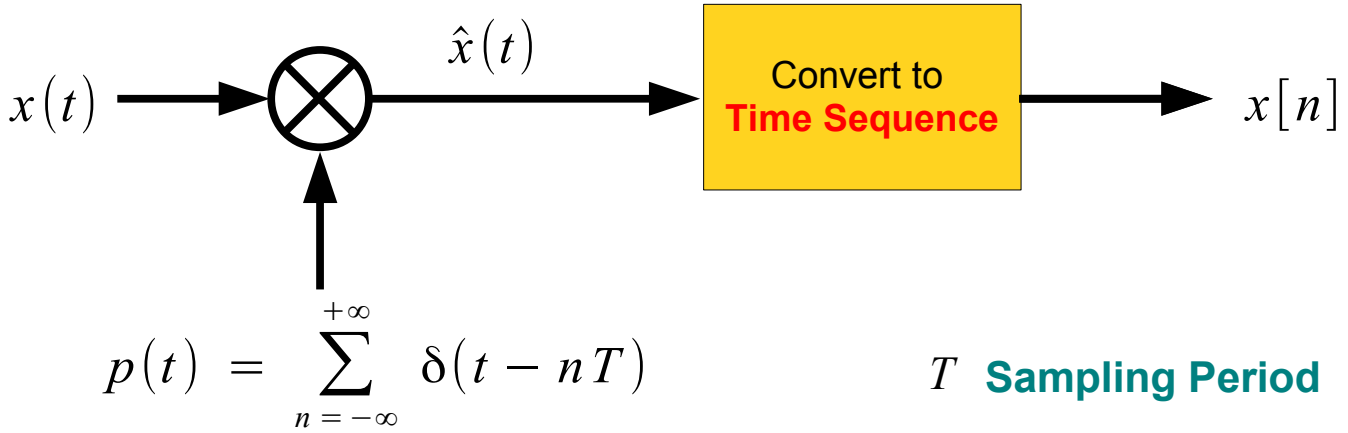
Time Sequence



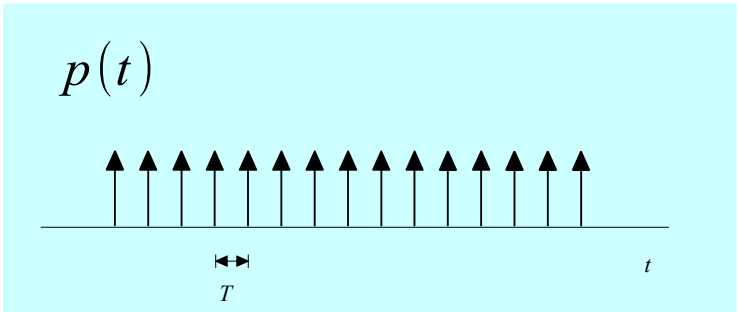


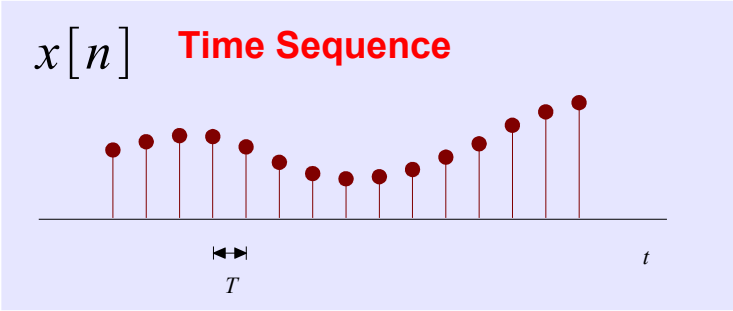


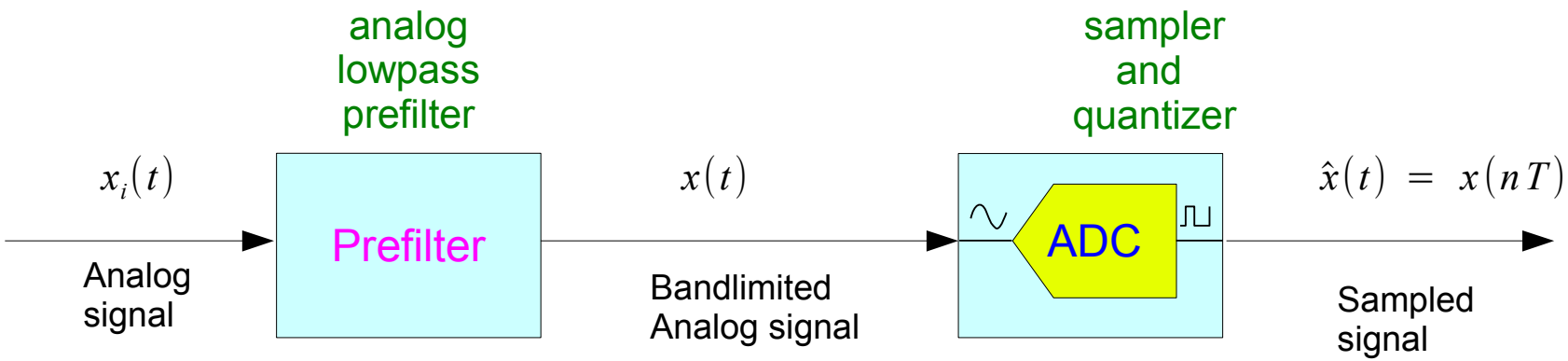
Ideal Sampling

$$p(t) = \sum_{n=-\infty}^{+\infty} \delta(t - nT)$$

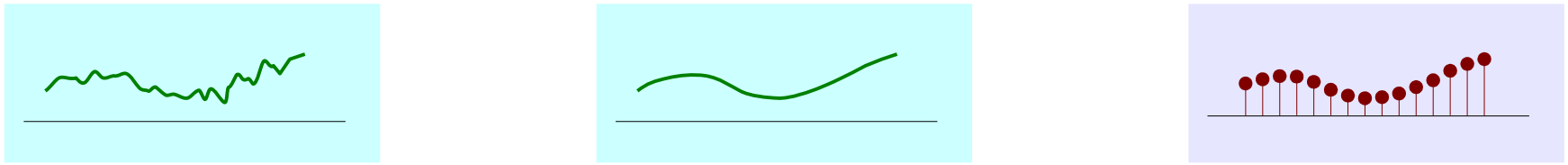
T **Sampling Period**

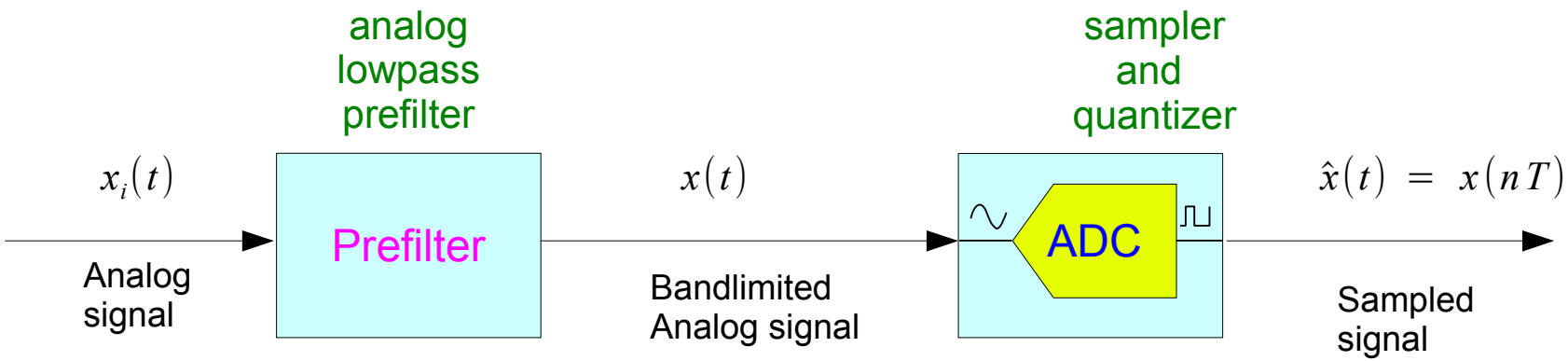


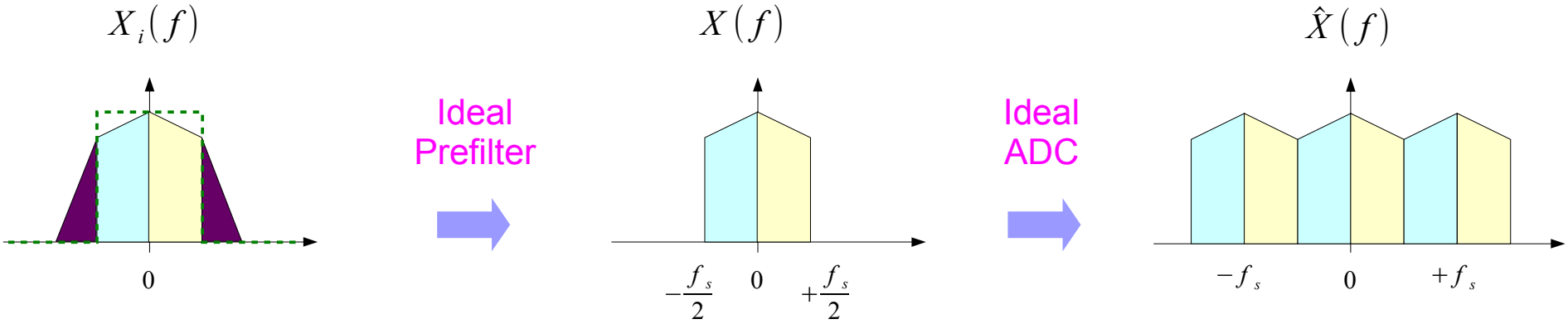


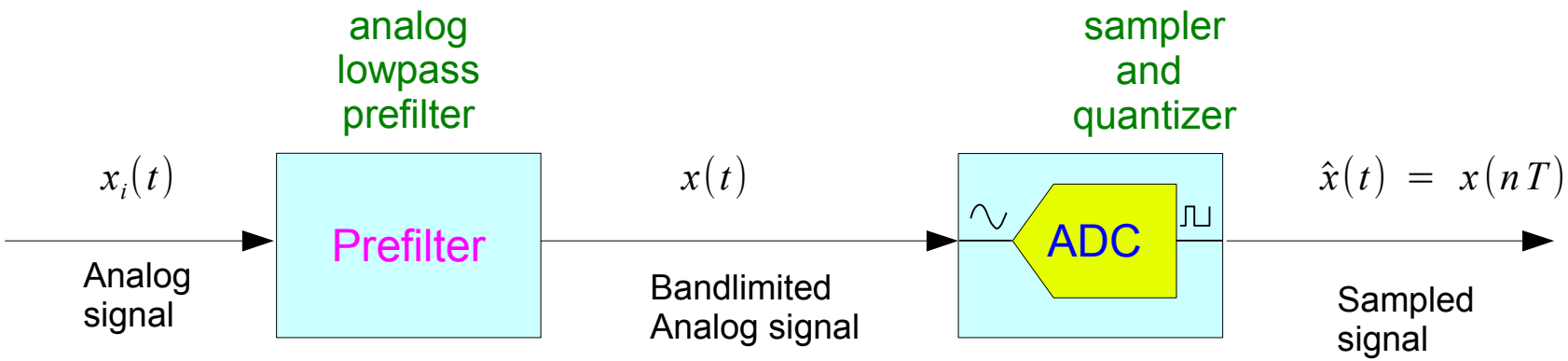


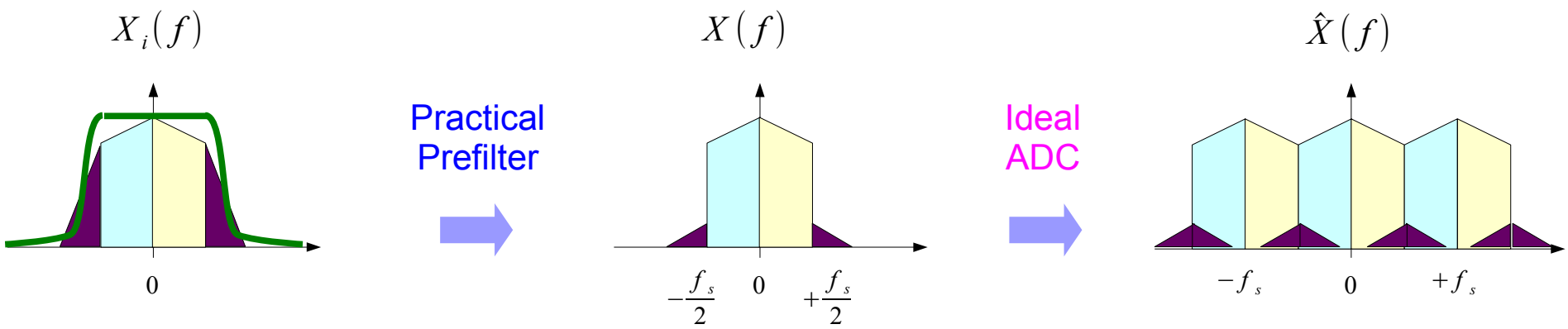
$x_i(t)$ $x(t)$ $\hat{x}(t) = x(nT)$

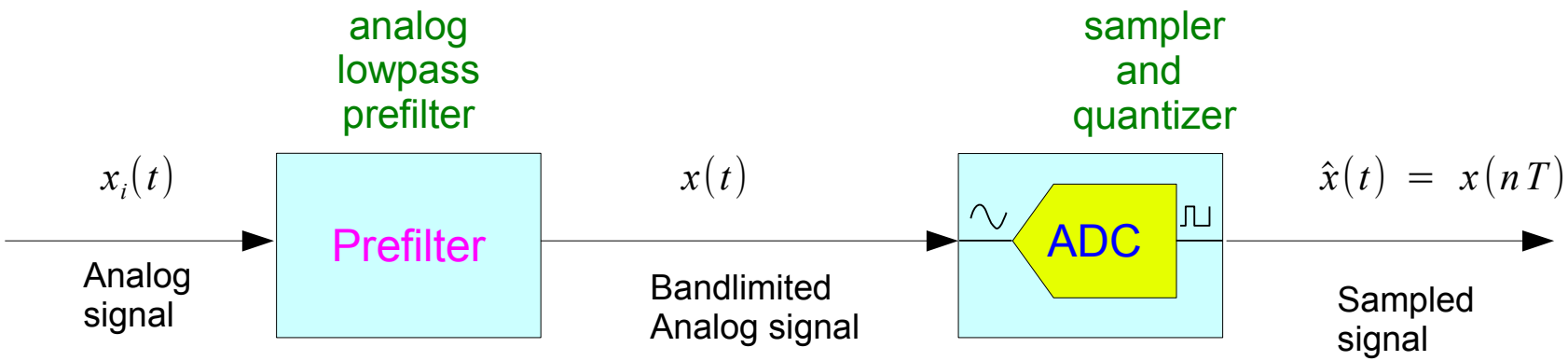


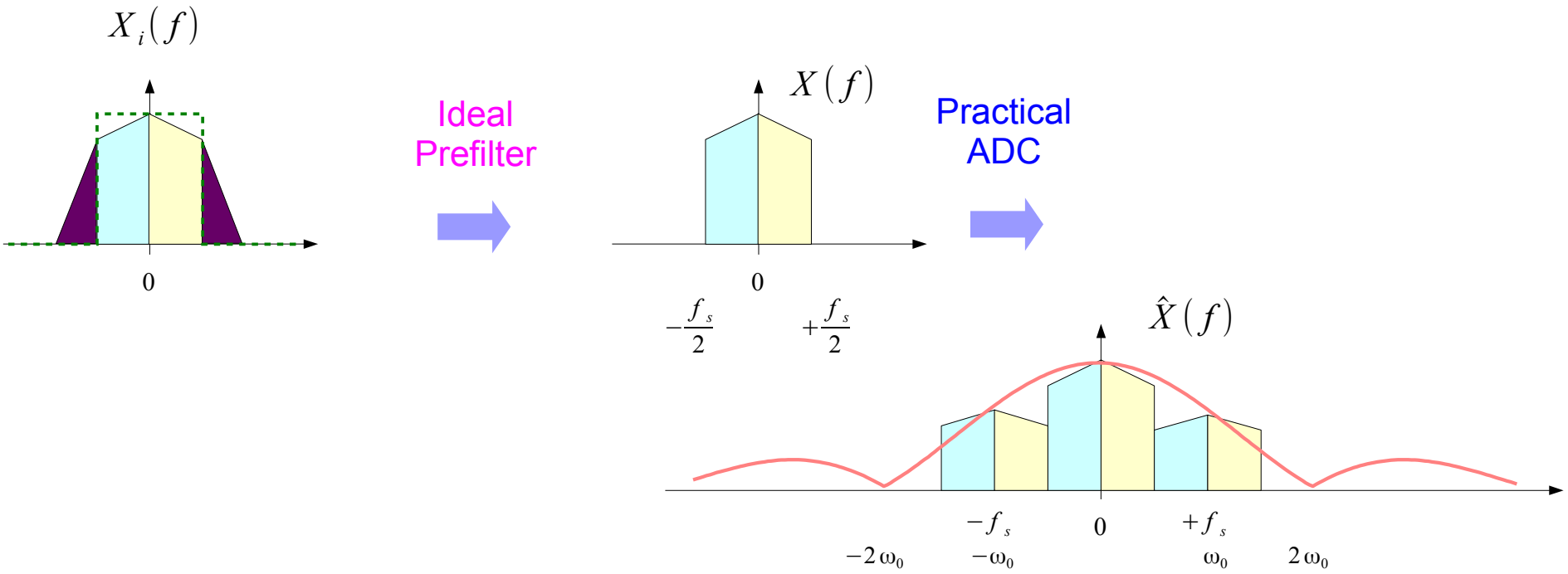

analog
lowpass
prefilter
sampler
and
quantizer
$x_i(t)$
Prefilter
$x(t)$
ADC
$\hat{x}(t) = x(nT)$
Analog
signal
Bandlimited
Analog signal
Sampled
signal


$X_i(f)$
$X(f)$
$\hat{X}(f)$
Ideal
Prefilter
Ideal
ADC
0
$-\frac{f_s}{2}$
0
$+\frac{f_s}{2}$
$-f_s$
0
$+f_s$


analog
lowpass
prefilter
sampler
and
quantizer
$x_i(t)$
Prefilter
$x(t)$
ADC
$\hat{x}(t) = x(nT)$
Analog
signal
Bandlimited
Analog signal
Sampled
signal

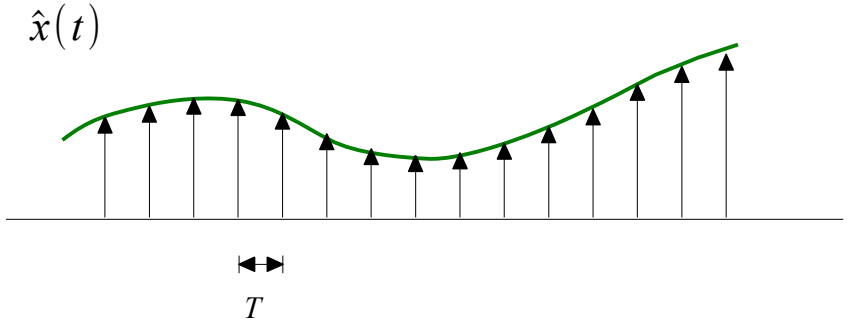

$X_i(f)$
$X(f)$
$\hat{X}(f)$
Practical
Prefilter
Ideal
ADC
0
$-\frac{f_s}{2}$
0
$+\frac{f_s}{2}$
$-f_s$
0
$+f_s$


analog
lowpass
prefilter
sampler
and
quantizer
$x_i(t)$
Prefilter
$x(t)$
ADC
$\hat{x}(t) = x(nT)$
Analog
signal
Bandlimited
Analog signal
Sampled
signal


$X_i(f)$
0
Ideal
Prefilter
$X(f)$
Practical
ADC
0
$-\frac{f_s}{2}$
$+\frac{f_s}{2}$
$\hat{X}(f)$
$-2\omega_0$
$-\omega_0$
$-f_s$
0
$+f_s$
ω_0
$2\omega_0$

Sampler

Ideal Sampling

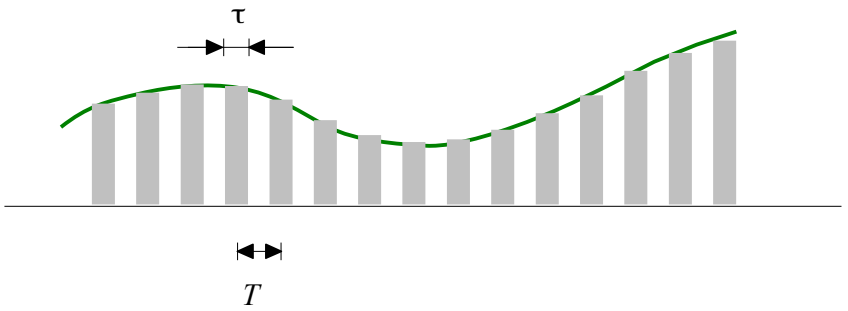


$$\hat{x}(t) = \sum_{n=-\infty}^{+\infty} x(nT)\,\delta(t-nT)$$

CTFT

$$\hat{X}(f) = \int_{-\infty}^{+\infty} \hat{x}(t)\, e^{-j2\pi f t}\, dt$$

Practical Sampling

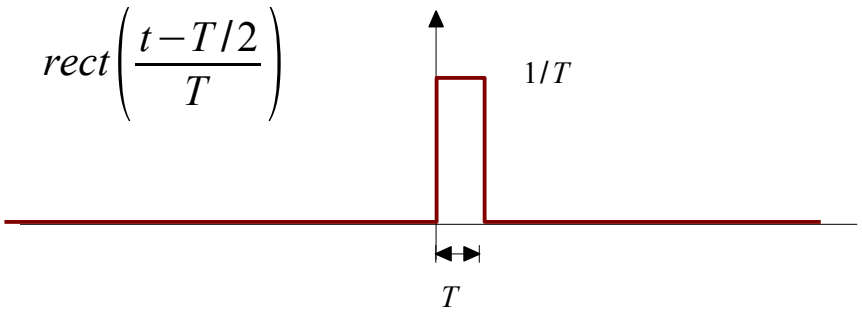


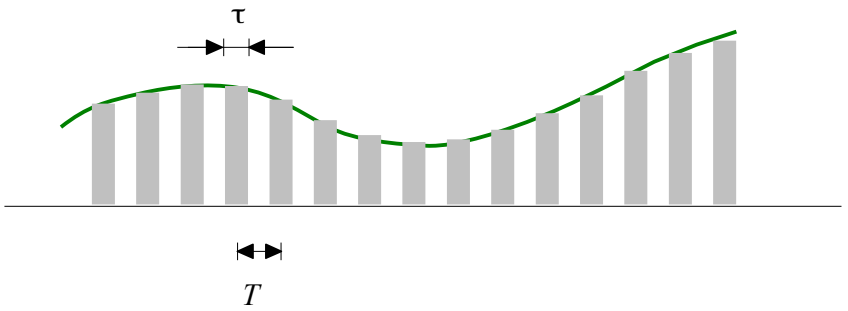
$$\hat{x}(t) \approx \sum_{n=-\infty}^{+\infty} x(nT)\,p(t-nT)$$

CTFT

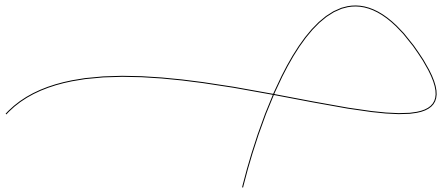
?

Zero Order Hold (ZOH)

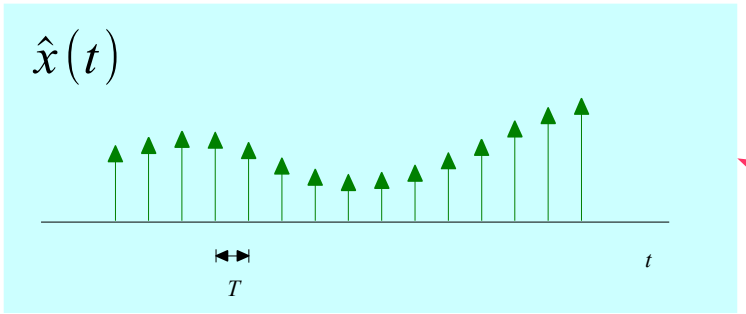


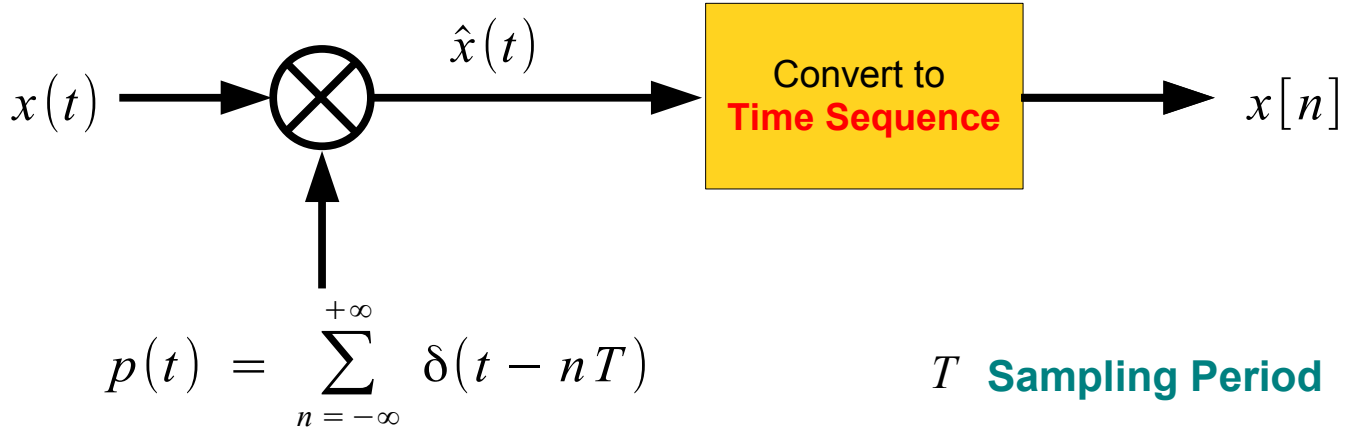


$$x_{ZOH}(t) = \sum_{n=-\infty}^{+\infty} x[n] \cdot rect\left(\frac{t-T/2-nT}{T}\right)$$



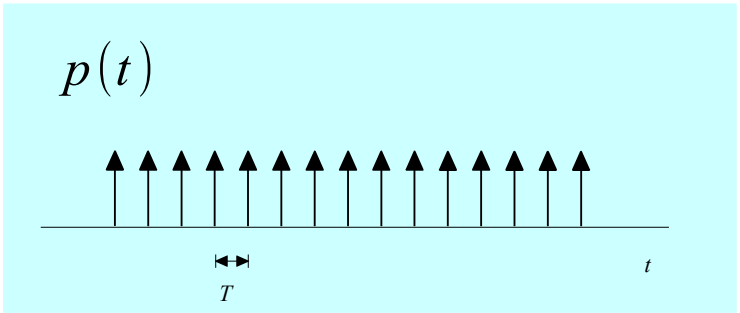
Time Sequence





Ideal Sampling

T **Sampling Period**



References

[1] http://en.wikipedia.org/
[2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003
[3] A "graphical interpretation" of the DFT and FFT, by Steve Mann
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[6] S.J. Orfanidis, Introduction to Signal Processing
www.ece.rutgers.edu/~orfanidi/intro2sp