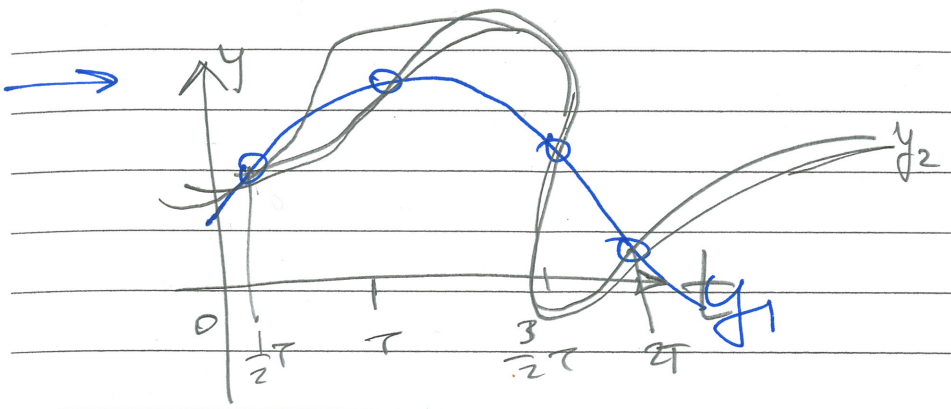
→ SPNS – ELEC 004 – LECTURE 8 – 4/27/2015 →



~~Nyqui~~ Nyquist

$y(t)$ is uniquely defined by samples $y(kT)$ if the sampling frequency is $2 \cdot B$ of $y(t)$

$$y(t) = \cos(\hat{\omega} t)$$

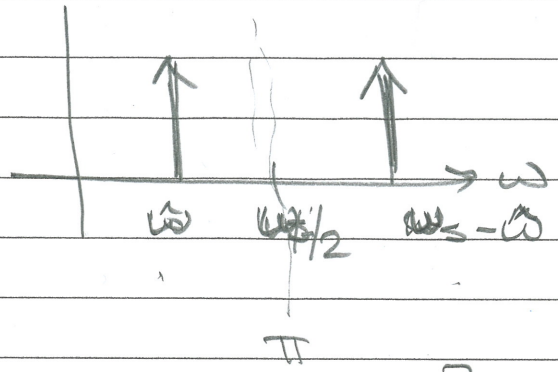
$$y(kT) = \cos(k \hat{\omega} T) = \cos(2\pi k \hat{\omega}/\omega_s)$$

If $(\omega_s - \hat{\omega})$

$$y_2 \rightarrow \cos((\omega_s - \hat{\omega})t) \rightarrow$$
$$\cos(2\pi k - 2\pi k \hat{\omega}/\omega_s) = \cos(2\pi k \hat{\omega}/\omega_s)$$

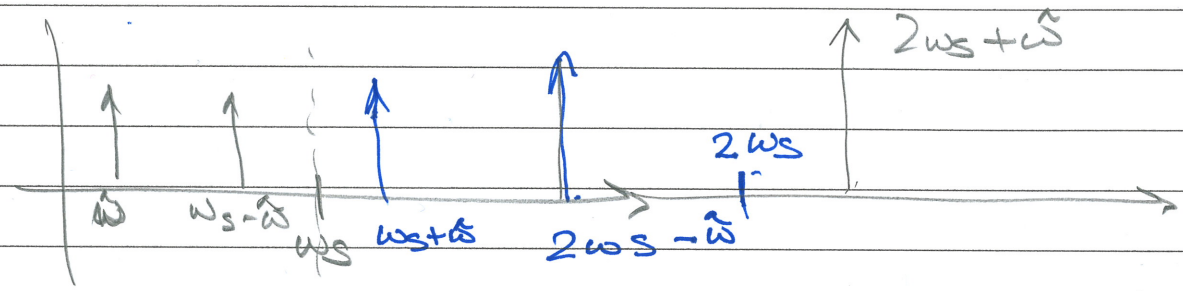
→ w/o an anti-aliasing filter you will recover

$$\omega_s - \hat{\omega} > \hat{\omega}$$



NORMALIZATION [0 1]

[0 2π]



→ Difference Equations ←
(Euler's Approximation)

$$\frac{dx}{dt} = \frac{x_{k+1} - x_k}{T}$$

$$D(s) = \frac{U(s)}{E(s)} = \frac{k(s+a)}{(s+b)}$$

$$(s+b) \cdot U(s) = k(s+a) \cdot E(s)$$

$$\frac{du(t)}{dt} + b\,u(t) = k\left(\frac{de(t)}{dt} + a\,e(t)\right)$$

$$\frac{du}{dt} + bu = k\left(\frac{de}{dt} + ae\right)$$

$$\frac{u_{k+1} - u_k}{T} + b u_k = k\left[\frac{e_{k+1} - e_k}{T} + a e_k\right]$$

$$u_{k+1} = (1 - bT)\, u_k + k e_{k+1} + k(aT - 1) \cdot e_k$$

$\therefore$ Diff. equations can be had from S/Laplace via Euler's approximation

! This will cause a cost!

$\rightarrow$ Coeff. will change w/ sample rate.