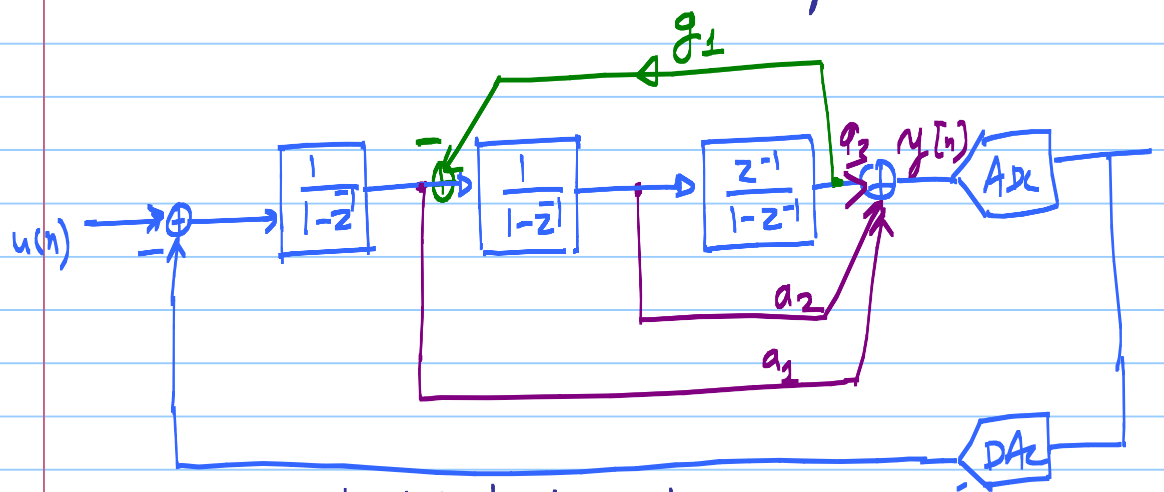
ECE 615 - Lecture 21

Note Title 11/14/2013

3rd-order NTF : Numerical Fitting Method ⟶ realize dsm_ct()



$g_1 = 0$

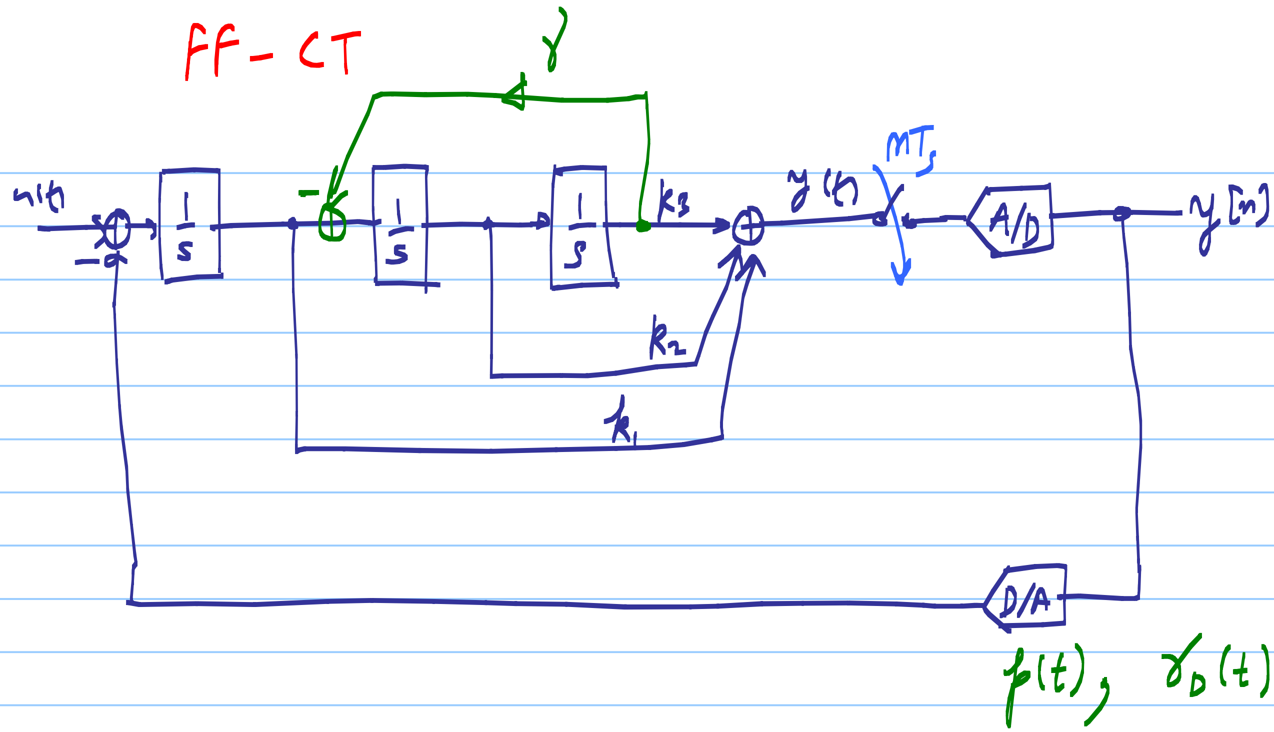
partial fraction expansion

$$L(z) = \frac{1}{1-z^{-1}} + \frac{(\cdot)}{(1-z^{-1})^2} + \frac{(\cdot)}{(1-z^{-1})^3}$$

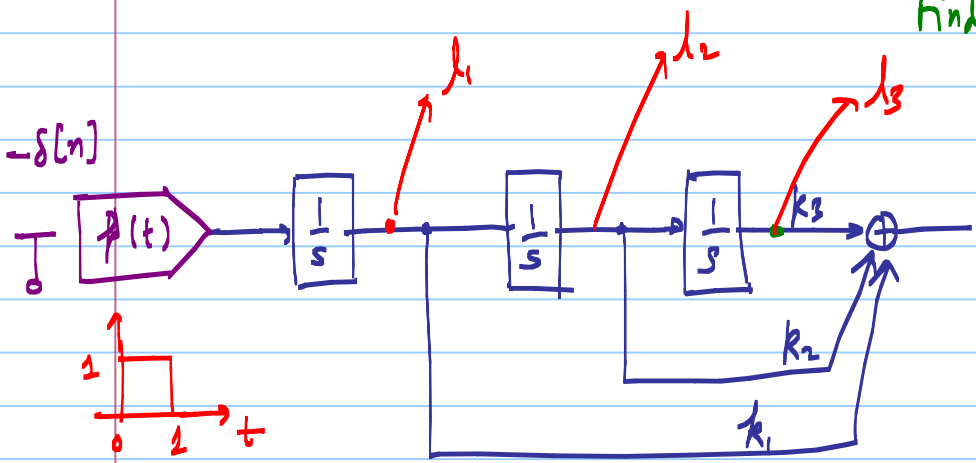
↓ Tables

$L(s)$

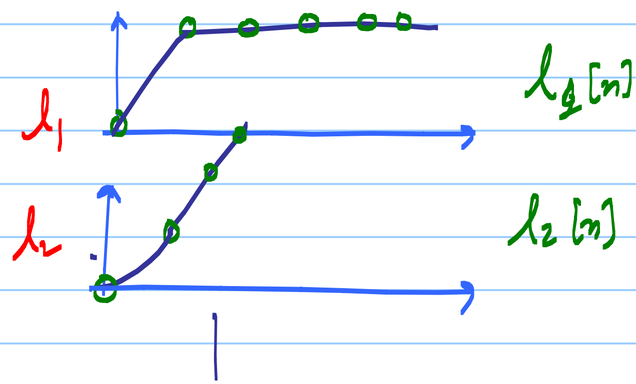
FF - CT

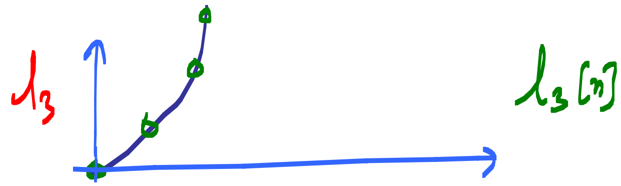


Find $K = [k_1 \; k_2 \; k_3]$



$f_s = 1$ Hz





loop impulse response $l[n]$ = DAC pulse shape passing through the loop filter & then sampled at the clock rate (f_s).

$$\underbrace{\begin{bmatrix} \frac{1}{s} & \frac{1}{s^2} & \frac{1}{s^3} \\ | & | & | \\ l_1 & l_2 & l_3 \\ | & | & | \end{bmatrix}}_{C} \underbrace{\begin{bmatrix} k_1 \\ k_2 \\ k_3 \end{bmatrix}}_{k} = \underbrace{\begin{bmatrix} l(0) \\ l[1] \\ l[2] \\ \vdots \end{bmatrix}}_{l}$$

$N \times 1$ vector

LMS fitting

$$\Rightarrow k^* = (C^T C)^{-1} (C^T \ell)$$

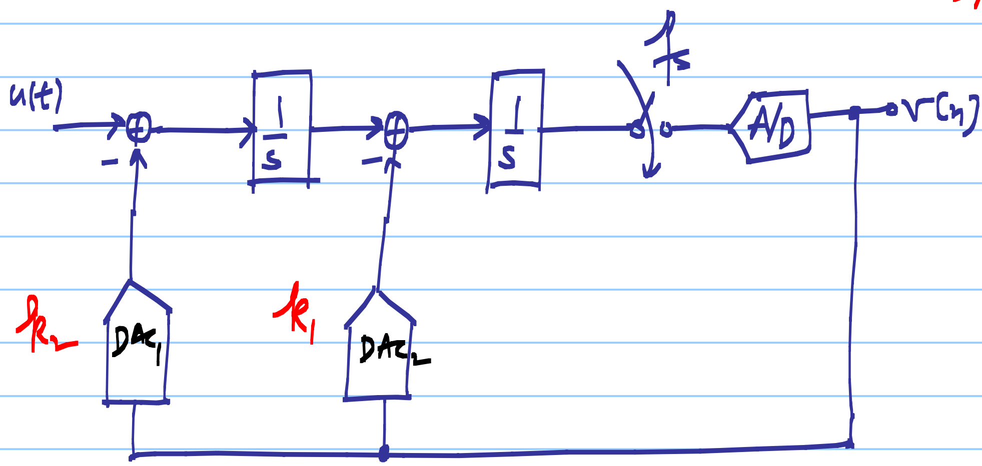
* least-squares fit to the $\ell[n]$, and we obtain

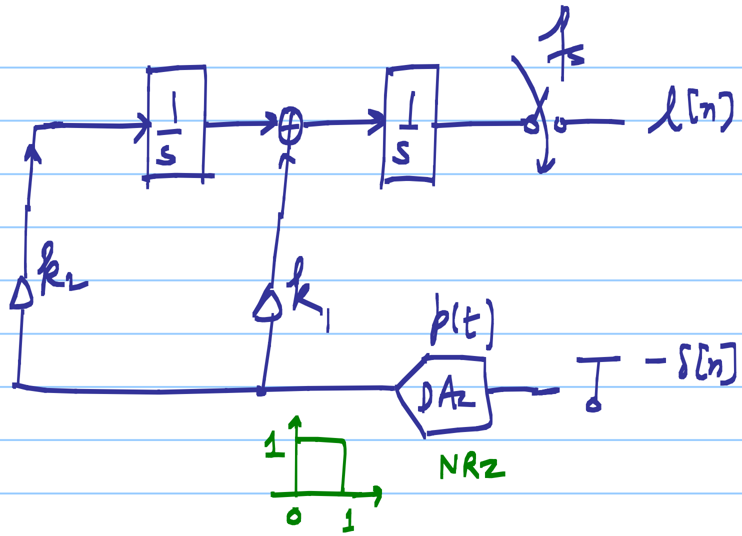
$$\begin{bmatrix} k_1 \\ k_2 \\ k_3 \end{bmatrix}$$

Feedback Topology

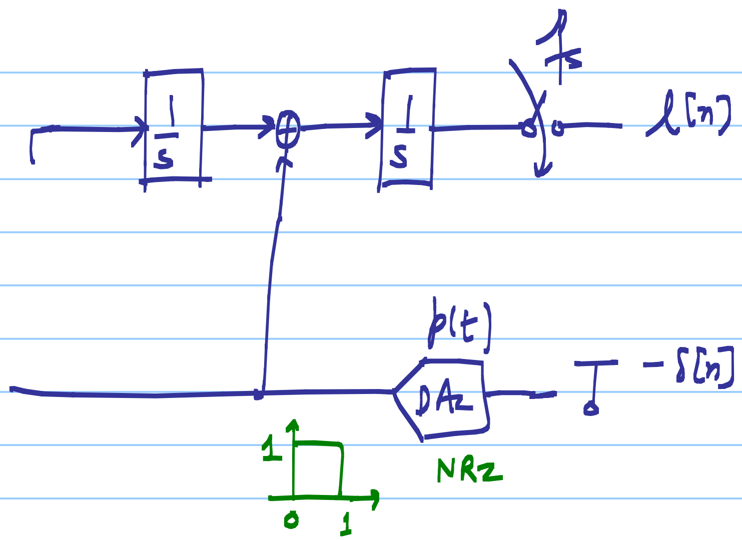
(2nd-order)

$$L(s) = \frac{k_1}{s} + \frac{k_2}{s^2}$$

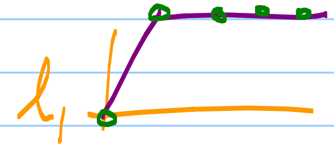




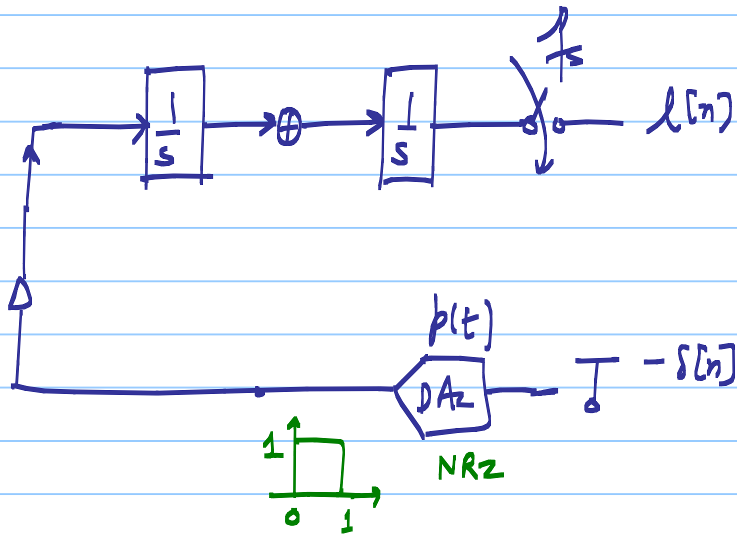
1/s
1/s
fs
l[n]
k2
k1
p(t)
DAz
-δ[n]
1
0
1
NRZ

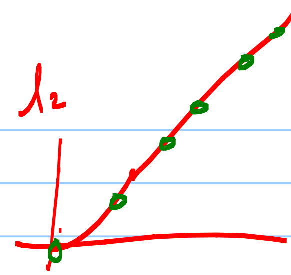


1
s
1
s
f_s
l[n]
p(t)
DAz
-δ[n]
1
0
1
NRz



l_1

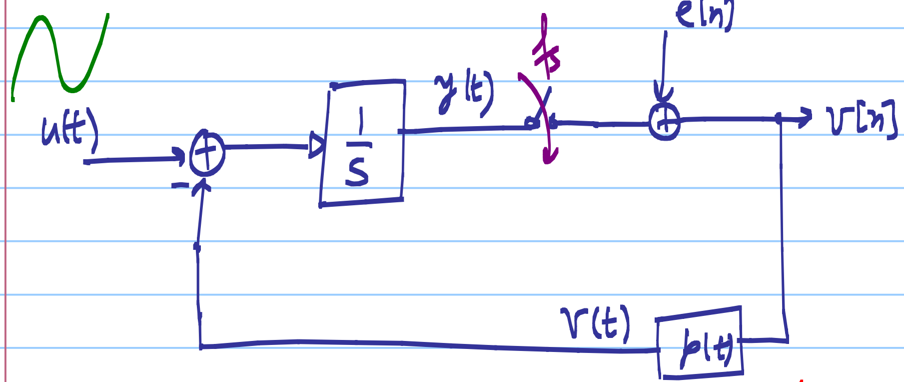




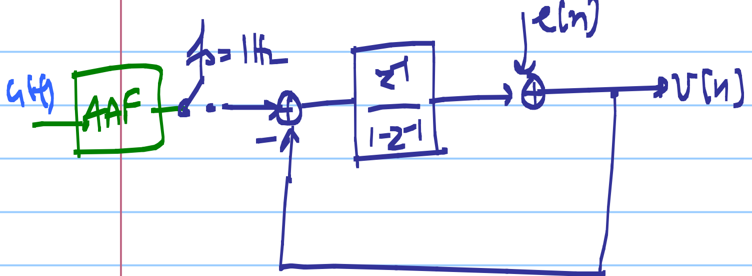
$$\begin{bmatrix} | & | \\ \ell_1 & \ell_2 \\ | & | \end{bmatrix} \begin{bmatrix} k_1 \\ k_2 \end{bmatrix} = \begin{bmatrix} \ell(0) \\ \ell(1) \\ \vdots \end{bmatrix}$$

"We'll see STF later"

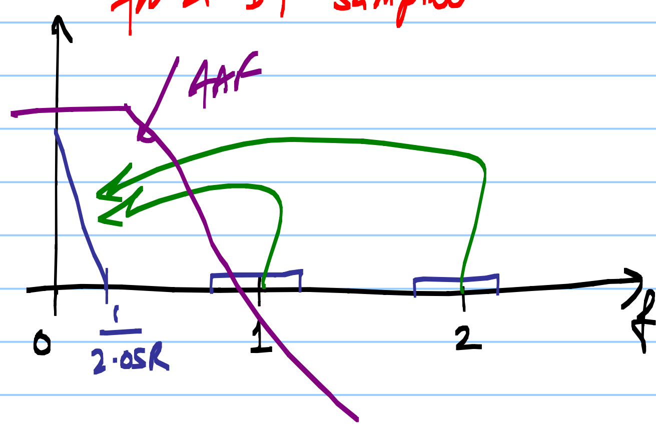
Anti-alias filtering in CT-ΔΣs

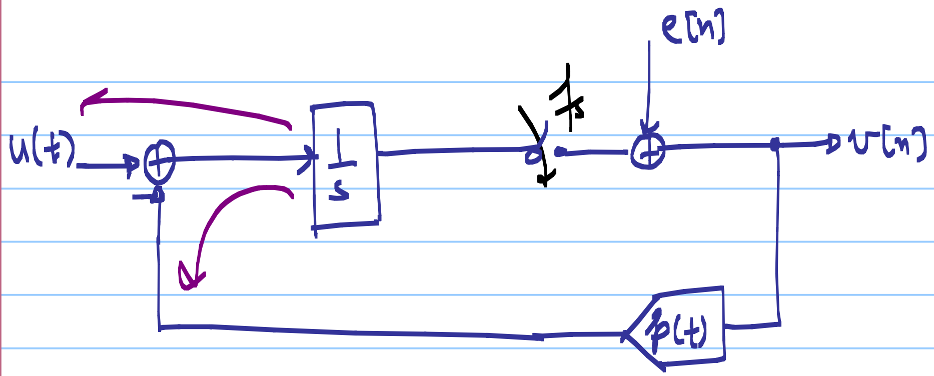


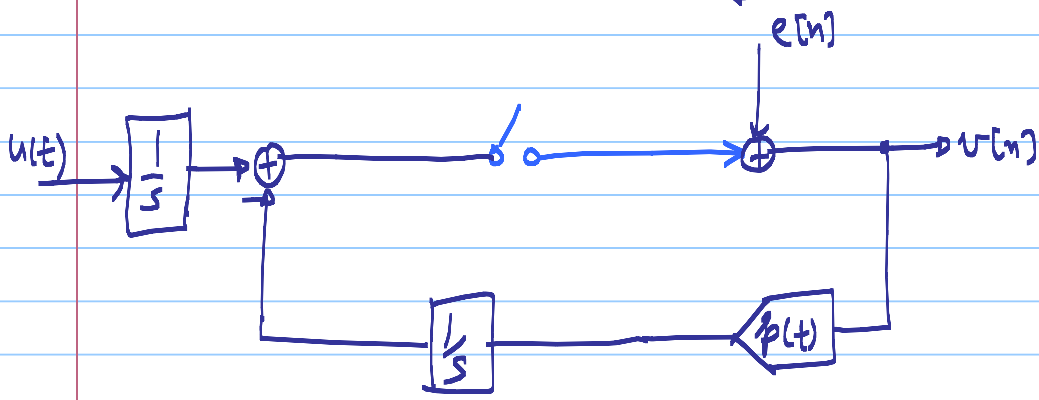
$f_s = 1$ Hz



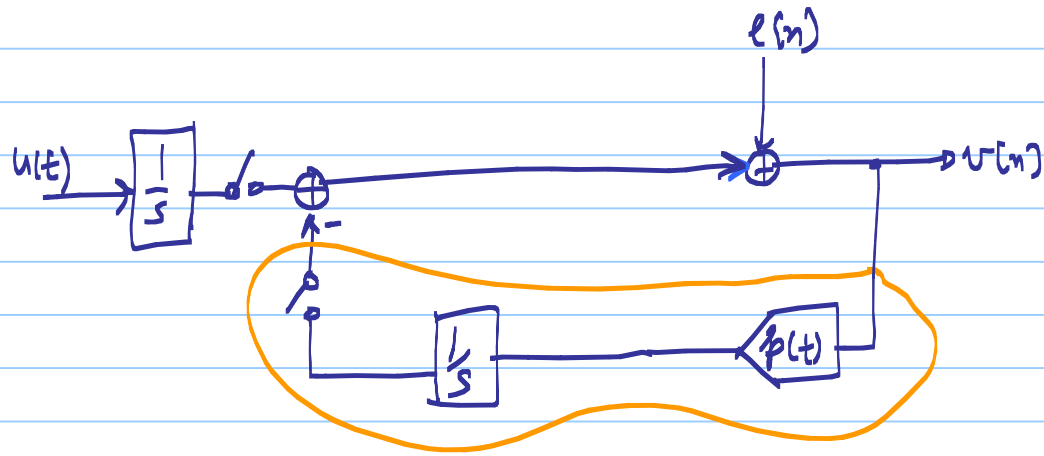
"for a DT sampler"



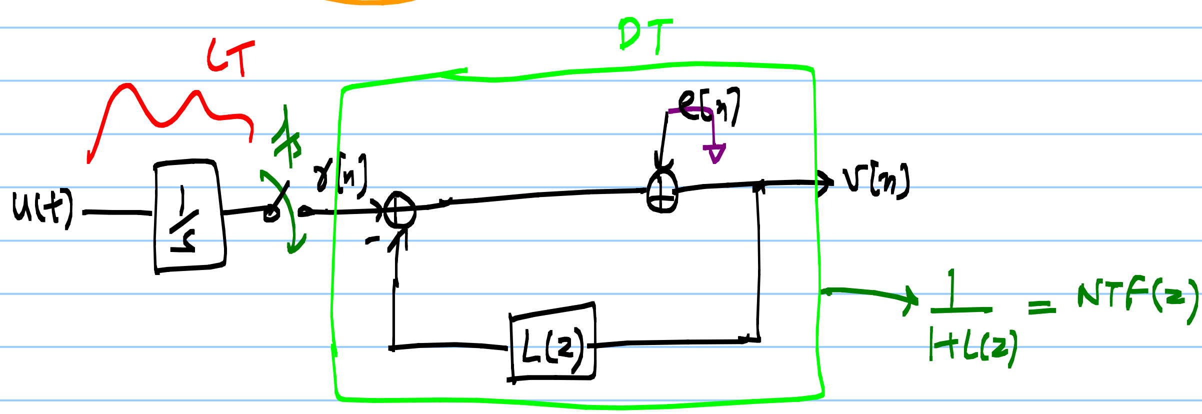




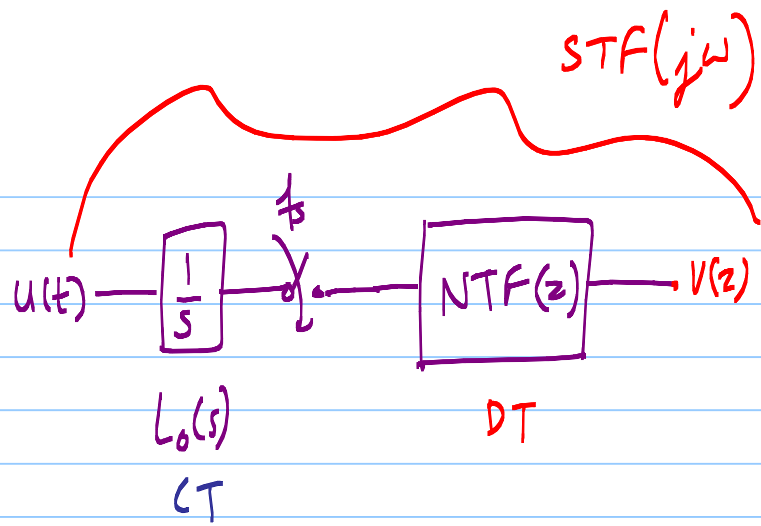
* Push 1/s out of the loop



e[n]
u(t)
1/s
v[n]
1/s
p(t)



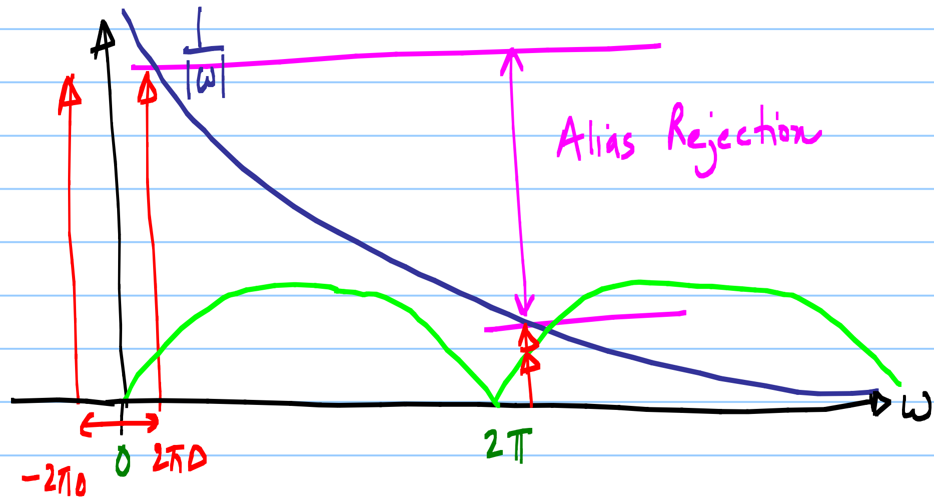
CT
DT
u(t)
1/s
fs
y[n]
e[n]
v[n]
L(z)
1/(1+L(z)) = NTF(z)



$AAF(s) = \frac{1}{s}$

↓

$L_0(j\omega) = \frac{1}{j\omega}$

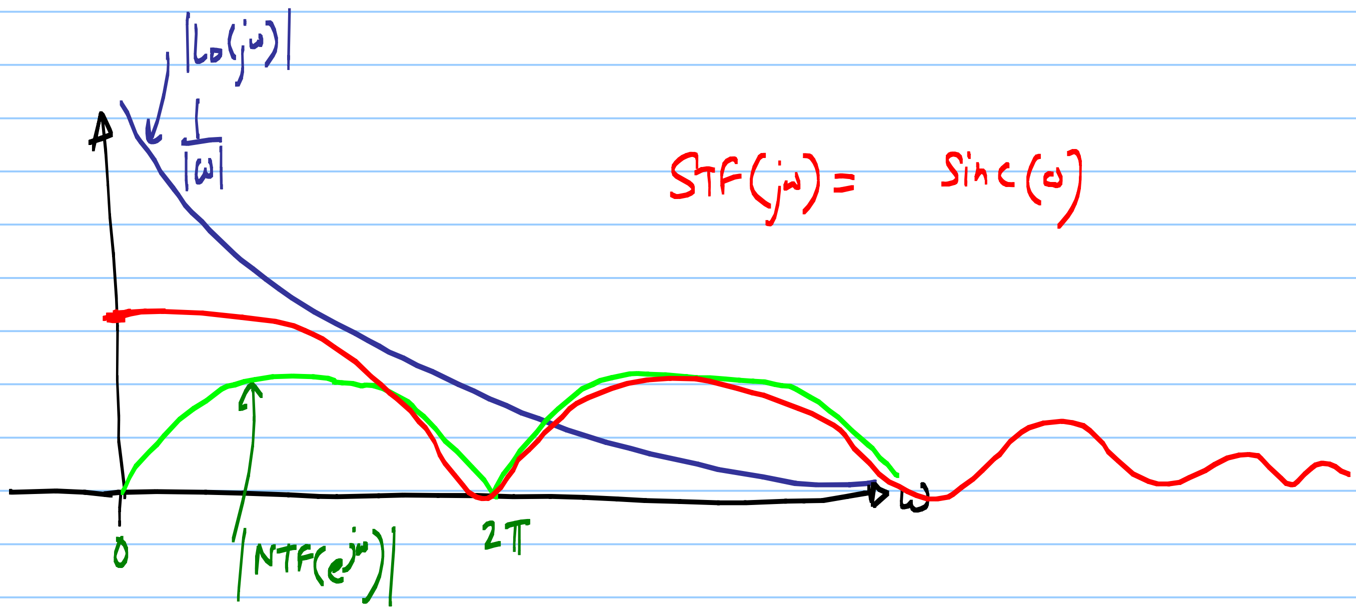


& for a sinusoidal input of frequency $2\pi\Delta$,

the alias rejection at frequency $2\pi(1+\Delta)$

$$\frac{1}{2\pi(1+\Delta)}$$

$$|STF(j\omega)| = |L_0(j\omega)| \cdot |NTF(e^{j\omega})|$$



$STF(j\omega) = \text{Sinc}(\omega)$