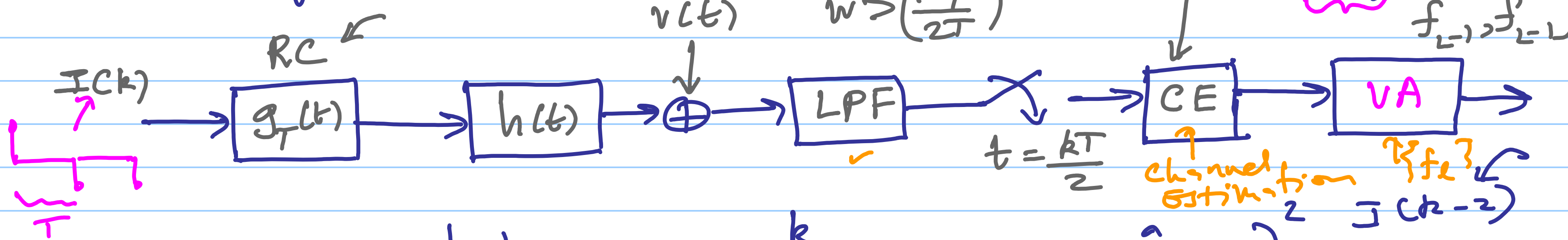
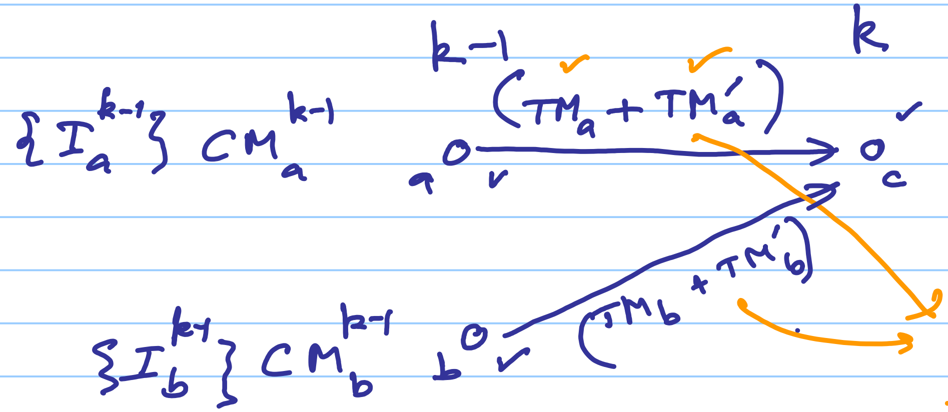
memory is $LT \to 2L$

$f(t) \to \{f_0, f_0', f_1, f_1', \ldots, f_{L-1}, f_{L-1}'\}$ (T, $T/2$)

Viterbi Algorithm @ Nyquist Rate





$TM_a + \left(r(k) - \hat{r}_{a\to c}(k)\right)^2$

$\hat{r}_{a\to c}(k) = \sum_{\ell=0}^{2} I(k-\ell) \cdot f_\ell$

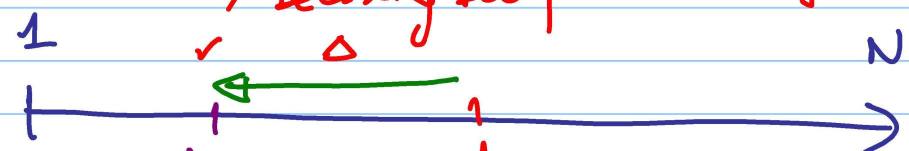
$TM_a' \to \hat{r}'_{a\to c}(k) = \sum_{\ell=0}^{2} I(k-\ell) \cdot f_\ell'$

$= v(kT),\ v(kT + T/2),\ v((k+1)T)$

$k \to kT$

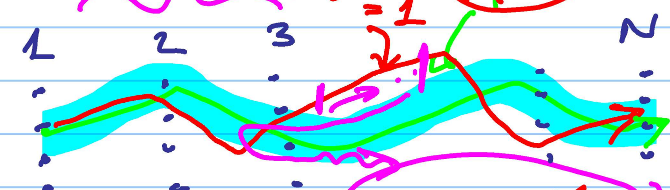
$$r(k) = g\left(\sum_{l=0}^{L-1} f_l\, I(k-l)\right) + v(k) \sim \mathcal{N}(0, \sigma_v^2)$$

$\hat{I}(k-\Delta)$ Decoding Delay → trace-back length



$\Delta \sim 4L$ to $5L$

systematic



Fano $= 1$

M^{L-1}

sub-optimal Δ → r.v.

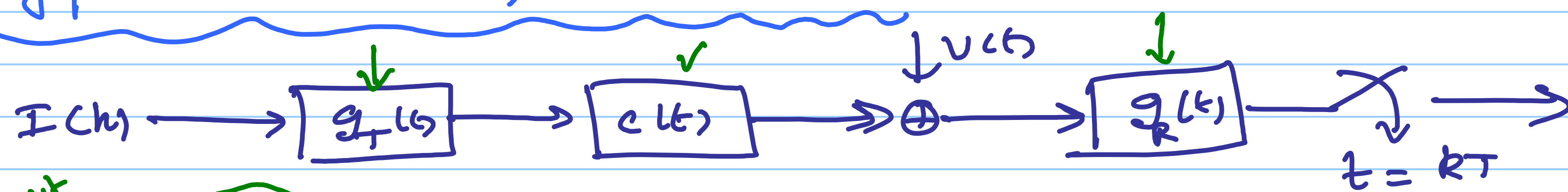
Fano, stack

$k \to \hat{I}(k-\Delta)$

ISI Model

- MAP-SE, MLSE — optimal SE
- Linear Equalization
  - ZF
  - L-MMSE ← Adaptive Algo's
- Non-Linear Equalization
  - DFE
  - Neural Network based Schemes (RBF)

Nyquist Criterion for Zero ISI



$x(t) = g_T(t) * c(t) * g_R(t)$ — Nyquist pulse

Chose $g_T(t)$ and $g_R(t)$ such that

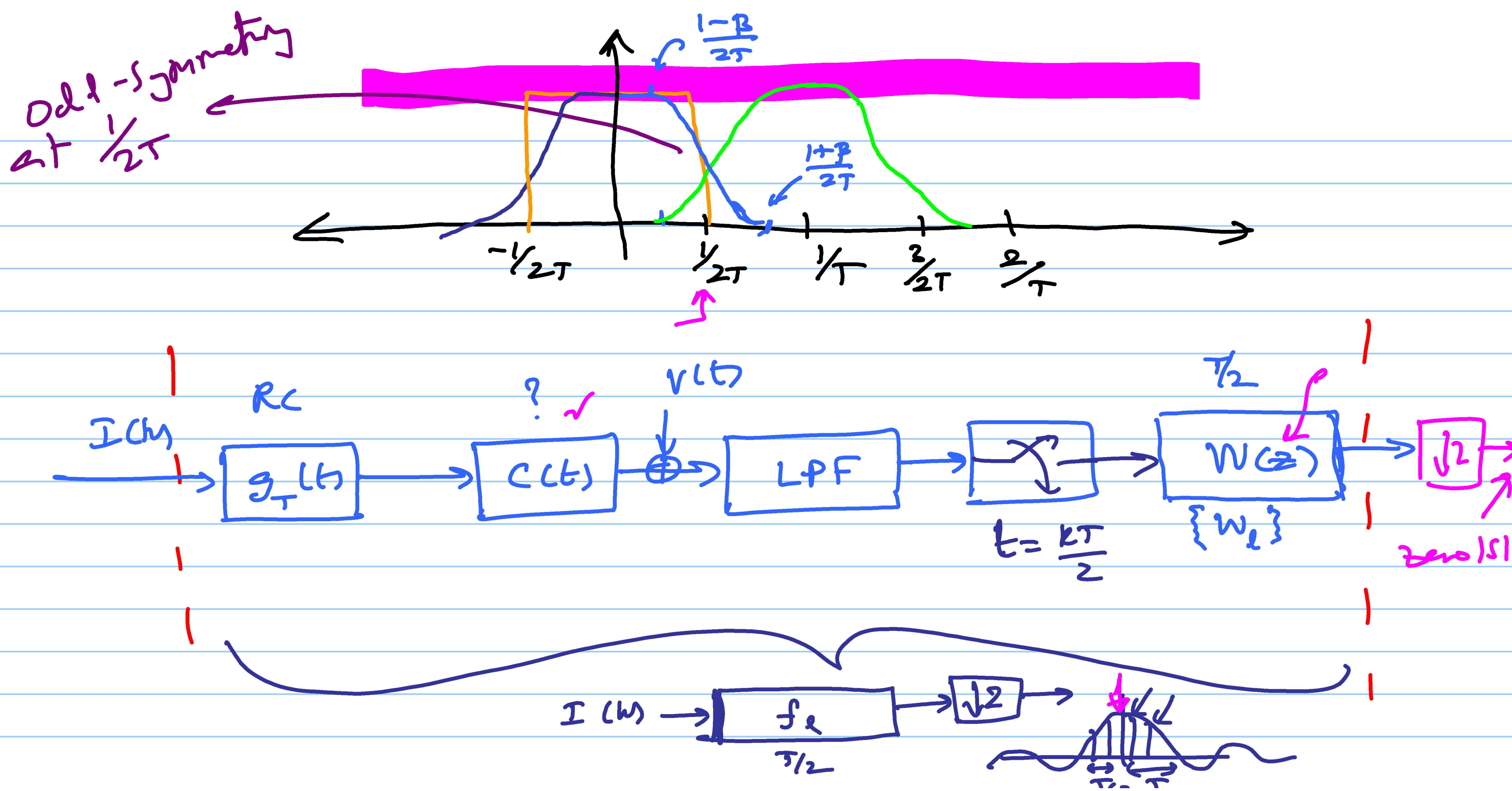
$$x(kT) = x(k) = \begin{cases} 1, & k = 0 \\ 0, & k \neq 0 \end{cases} \longrightarrow (1)$$

$x(t) \rightleftharpoons X(f)$, $x[nT_s] \rightleftharpoons \frac{1}{T_s}\sum_n X\left(f - \frac{n}{T_s}\right)$

<u>Theorem</u>: The necessary and sufficient condition for $x(t)$ to satisfy (1) is that $x(t) \rightleftharpoons X(f)$

$$\sum_{m=-\infty}^{+\infty} X\left(f + \frac{m}{T}\right) = T$$

Folded spectrum must be flat (sampled spectrum)



Odd-symmetry at 1/2T
1-β/2T
1+β/2T
-1/2T
1/2T
1/T
3/2T
2/T
RC
?
v(t)
T/2
I(t)
g_T(t)
C(t)
LPF
W(z)
↓2
t= kT/2
{W_l}
zero ISI
I(t)
f_l
↓2
T/2

Note Title 09-11-2020