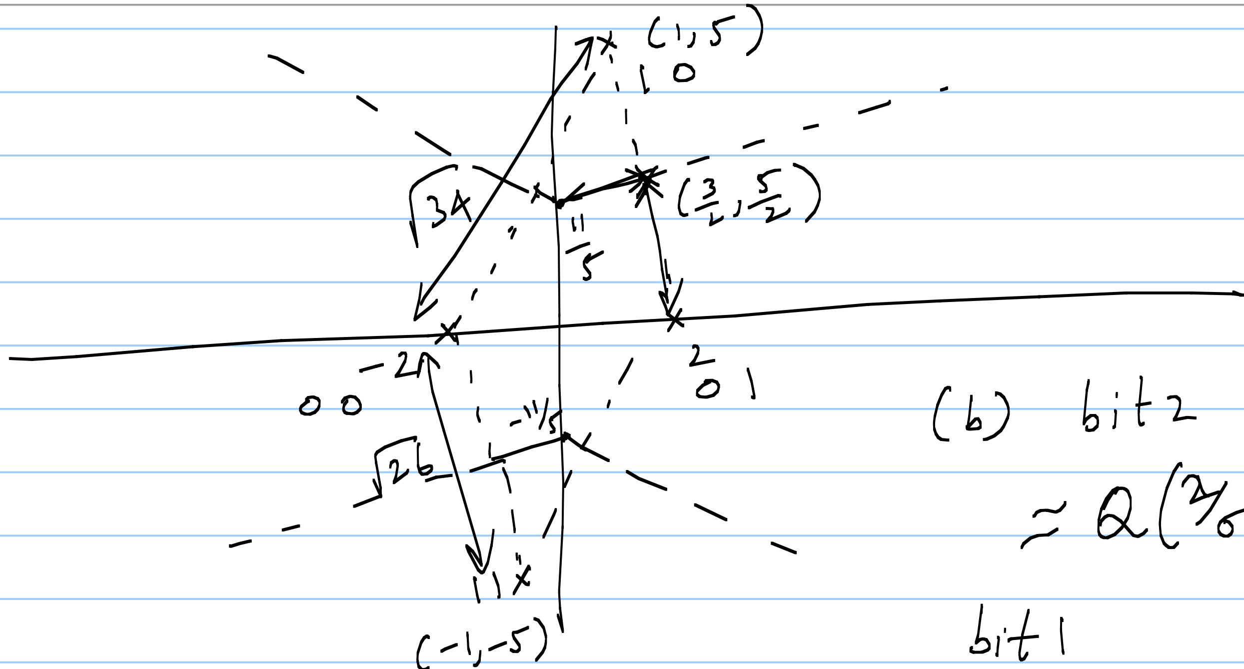
Lecture 34

Note Title 10/14/2008

1 (a)



(b) bit 2

$$\simeq Q\left(\frac{3}{\sigma}\right)$$

bit 1

$$\simeq 2Q\left(\frac{\sqrt{26}}{2\sigma}\right)$$

(2)

$$H(z) = 1$$

$$S_n(z) = \frac{1}{3 - 2\left(\frac{z+z^{-1}}{2}\right)^2} = \frac{2}{4 - z^2 - z^{-2}}$$

$$4 - z^2 - z^{-2} = -z^{-2}\left(z^4 - 4z^2 + 1\right)$$

$$= -z^{-2}\left(z^2 - (2-\sqrt{3})\right)\left(z^2 - (2+\sqrt{3})\right)$$

$$\downarrow \text{min phase} \qquad \downarrow \text{max phase}$$

$$= +\left(1 - (2-\sqrt{3})z^{-2}\right)\left(2+\sqrt{3} - z^2\right)$$

$$= (2+\sqrt{3})\left(1 - (2-\sqrt{3})z^{-2}\right)\left(1 - (2-\sqrt{3})z^2\right)$$

$$S_n(z) = \underbrace{\frac{2}{2+\sqrt{3}}}_{\gamma_n^2} \cdot \underbrace{\frac{1}{1-(2-\sqrt{3})z^{-2}}}_{M_n(z)} \cdot \underbrace{\frac{1}{1-(2-\sqrt{3})z^2}}_{M_n^*(1/z^*)}$$

$$S_z(z) = 1 + \frac{2}{4 - z^2 - z^{-2}} = \frac{6 - z^2 - z^{-2}}{4 - z^2 - z^{-2}}$$

$$= \frac{(3+\sqrt{8})\left(1-(3-\sqrt{8})z^{-2}\right)\left(1-(3-\sqrt{8})z^{2}\right)}{\underbrace{(2+\sqrt{3})}_{\gamma_z^2}\underbrace{\left(1-(2-\sqrt{3})z^{-2}\right)}_{M_z(z)}\underbrace{\left(1-(2-\sqrt{3})z^{2}\right)}_{M_z^*(1/z^*)}}$$

ZF-DFE

$$\frac{2}{2+\sqrt{3}}$$

MMSE-DFE

$$\frac{2}{3+\sqrt{8}}$$

(3)(a)

$$H(f) = G(f)\left(1 + \frac{5}{2} e^{-j2\pi fT} + e^{-j4\pi fT}\right)$$

MF: $$H^*(f) = G^*(f)\left(1 + \frac{5}{2} e^{j2\pi f(T)^{\tau_1}} + e^{j4\pi f(T)^{\tau_2}}\right)$$

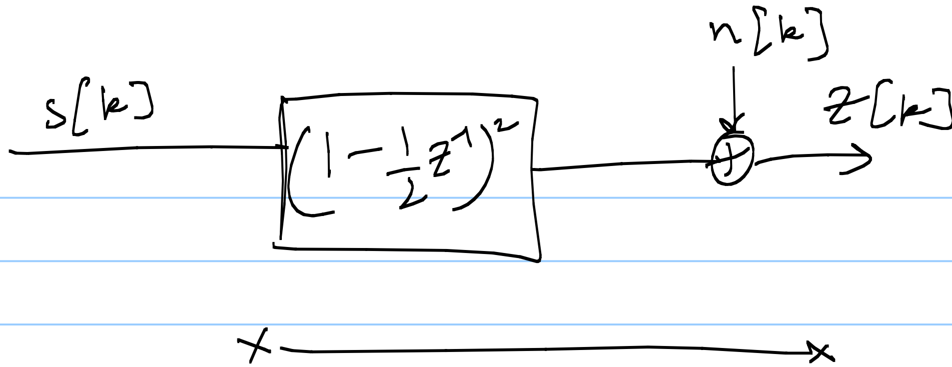
folded spectrum $$S(e^{j2\pi fT}) = \frac{1}{T}\sum_{m=-\infty}^{\infty} \left|H\left(f - \frac{m}{T}\right)\right|^2$$

$$= \frac{1}{T}\sum_{m=-\infty}^{\infty} \left|G\left(f - \frac{m}{T}\right)\right|^2 \cdot |C(f)|^2$$

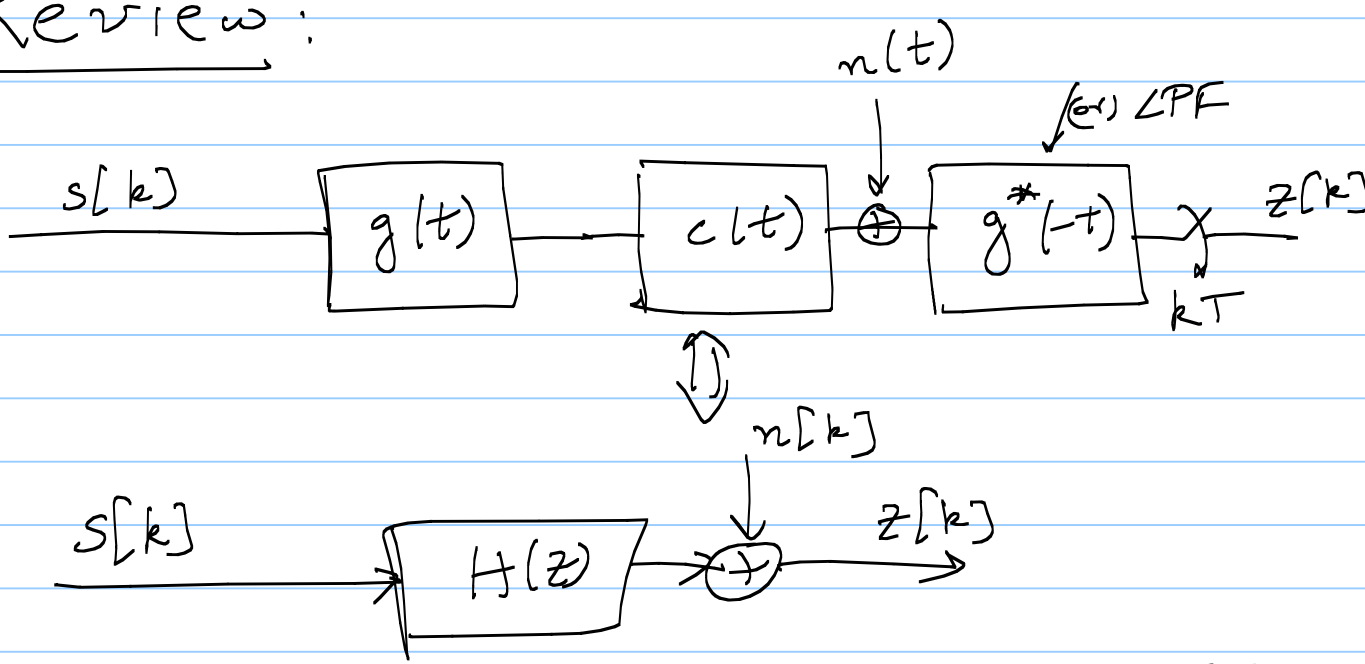
$$= |C(f)|^2$$

$$S(z) = \left(1 + \frac{5}{2} z^{-1} + z^{-2}\right)\left(1 + \frac{5}{2} z + z^2\right)$$

$$= \underset{\gamma_1^2}{4}\left(1 + \frac{1}{2} z^{-1}\right)^2 \left(1 + \frac{1}{2} z\right)^2 \rightarrow m^*(1/z^*)$$



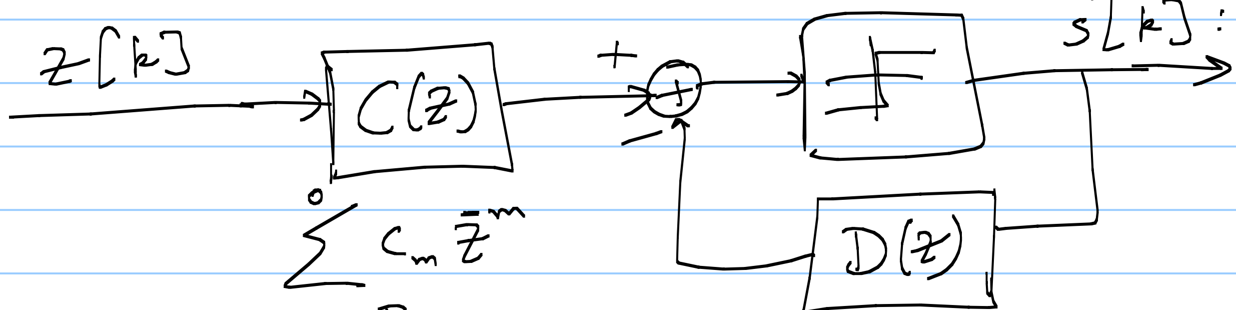
Review:



→ No constraint on complexity ⇒ ZF-DFE (or) MMSE-DFE
(know H(z))

→ finite-tap equalizers (know $H(z)$) ⇒ linear equation solving

→ finite-tap equalizer (dont know $H(z)$) ⇒ LMS algorithm



$\hat{s}[k]$: known during training phase

$C(z) = \sum_{m=-p}^{0} c_m z^{-m}$

$D(z) = \sum_{m=1}^{p'} d_m z^{-m}$

$$\underline{c}_k = \begin{bmatrix} c_{-p} \\ \vdots \\ c_0 \\ d_1 \\ \vdots \\ d_{p'} \end{bmatrix}$$

$$\underline{c}_{k+1} = \underline{c}_k + \beta \, e[k] \, \underline{z}_k^*$$

- Very practical receivers.
- DPSK, ...
- OFDM
- Coding