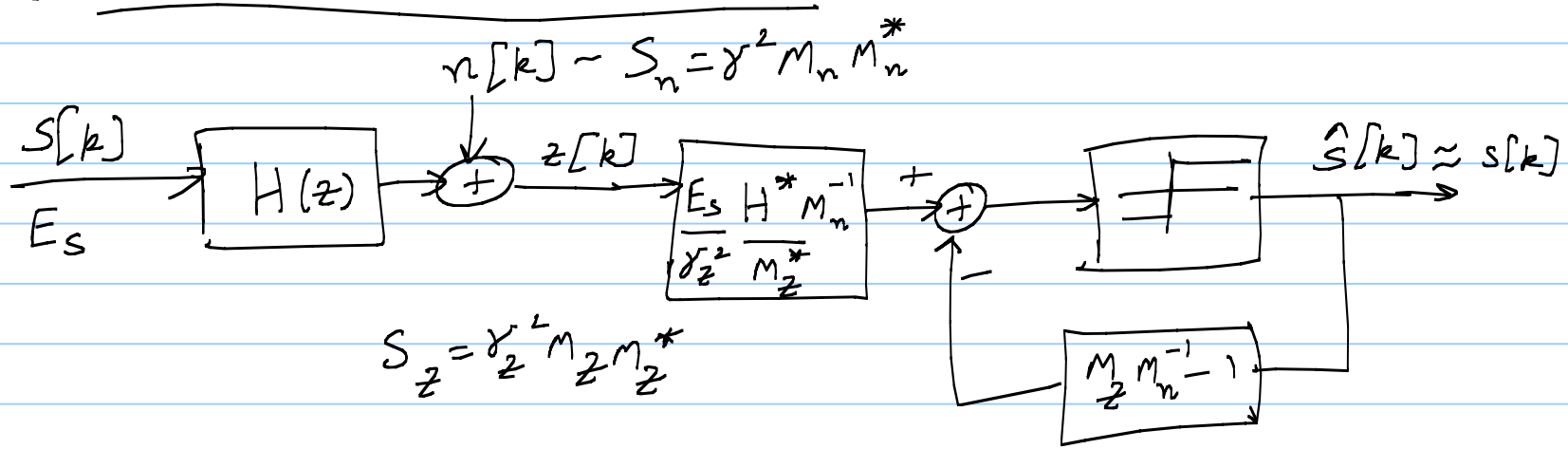
Lecture 31

Note Title 9/29/2008

Unbiased MMSE DFE



$$e'[k] = x[k] - s[k] \quad \text{"slicer error"}$$

("symbol")

$$= s[k] * h[k] * h_{pre}[k] - s[k] * h_{post}[k] - s[k]$$

$$= s[k] * h[k] * h_{pre}[k] - s[k] * (h_{post}[k] + \delta[k])$$

$$E' = S\left[H D W - W\right]$$

$$\frac{E'}{S} = \underbrace{H \cdot E_s \; H^*}_{\gamma_z^2 \;\; M_z^*} M_n^{-1} - M_z M_n^{-1}$$

channel — precursor

$$e'[k] \overset{ZT}{\longleftrightarrow} \frac{E'}{S} = \frac{-\gamma_n^2}{\gamma_z^2} \frac{M_n^*}{M_z^*}$$

$\frac{E'}{S} \overset{ZT}{\longleftrightarrow} s[k]$

$\frac{M_n^*}{M_z^*}$ → monic

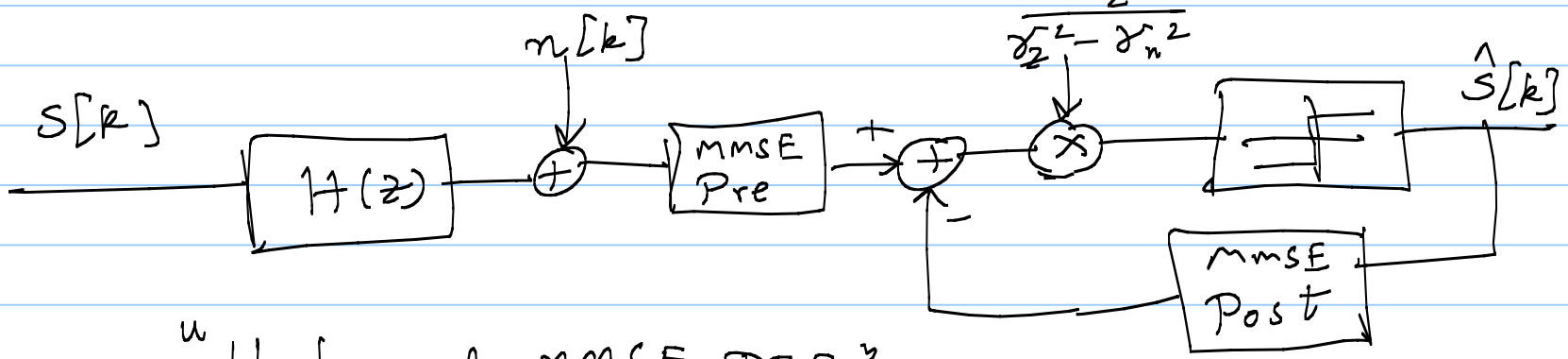
$$e'[k] = \cdots + \left(\frac{-\gamma_n^2}{\gamma_z^2} s[k]\right) + \cdots$$

Symbol component at slicer input $= \cdots\cdots + s[k] - \frac{\sigma_n^2}{\sigma_z^2} s[k] + \cdots\cdots$

$$= \left(1 - \frac{\sigma_n^2}{\sigma_z^2}\right) s[k]$$

$\rightarrow$ Slicer input is "biased" about $s[k]$.

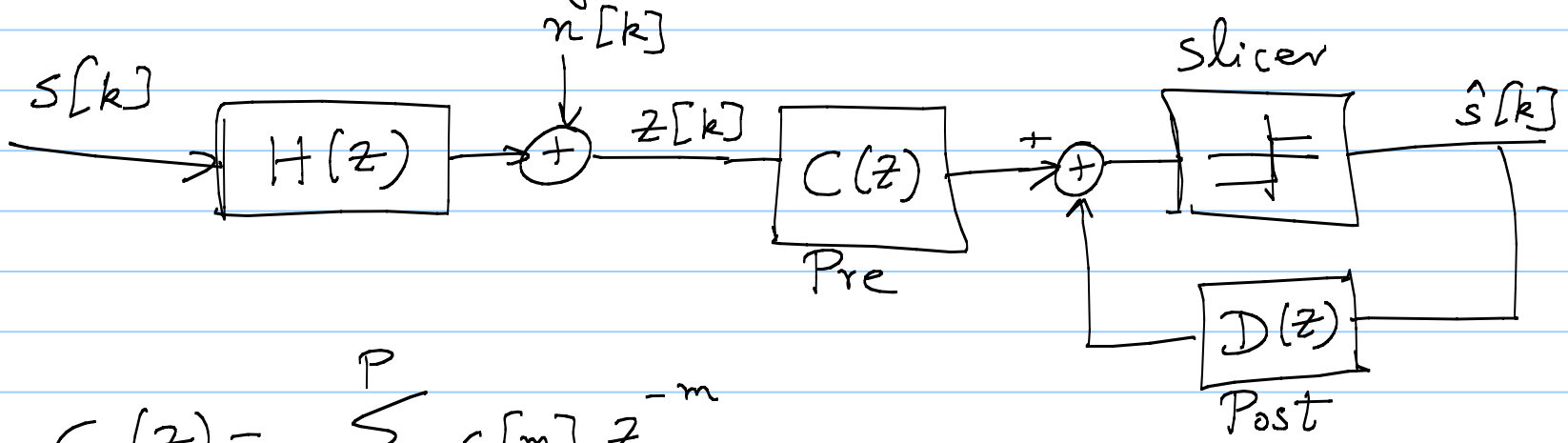
MMSE-DFE is biased.



"Unbiased MMSE DFE"

Constrained Complexity Equalizers

→ Linear Algebra



$$C(z) = \sum_{m=-P}^{P} c[m]\, z^{-m}$$

$$D(z) = \sum_{m=1}^{P} d[m]\, z^{-m}$$

$$\underline{z}_k = \begin{bmatrix} z[k+p] \\ \vdots \\ z[k] \\ \vdots \\ z[k-p] \end{bmatrix}$$

$$\text{o/p of Precursor} = z[k] * c[k]$$

$$= \sum_{m=-L}^{L} c[m]\, z[k-m]$$

$$= \underline{c}^T \underline{z}_k$$

$$\underline{c}^T = \begin{bmatrix} c[-L] & \cdots & c[0] & \cdots & c[L] \end{bmatrix}$$

MSE-LE :

$$e[k] = x[k] - s[k]$$

$$= \underline{c}^T \underline{z}_k - s[k]$$

$\underline{c}$: constant vector

$\underline{z}_k$: vector from the random process

$s[k]$: Random process

$$z[k] = s[k] * h[k] + n[k]$$

$$MSE = E\left[|e[k]|^2\right] = E\left[\left(\underline{c}^{*T}\underline{z}_k^* - s^*[k]\right)\left(\underline{c}^T\underline{z}_k - s[k]\right)\right]$$

$$= E\left[|s[k]|^2\right] + \underline{c}^{*T} E\left[\underline{z}_k^* \underline{z}_k^T\right] \underline{c} - \ldots\ldots$$

($\underline{z}_k^T \underline{c}$ = $\underline{c}^T \underline{z}_k$)