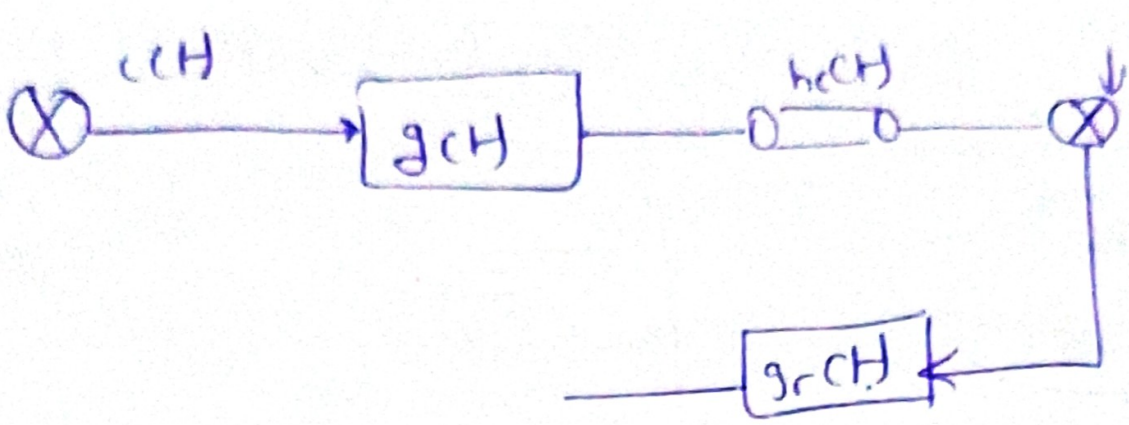


Chap 4

$$c(H) * g(H) * h_c(H) * g_r(H) + b(H) * g_r(H)$$

$$h(H)$$

$$= c(H) * h(H) + n(H)$$

après blanchiment

$$= c(H) * h(H) + n(H)$$

blanchiment

$b(H) \rightarrow \gamma_B(f) = \frac{N_0}{2}$

$\gamma_N(f) = \frac{N_0}{2} |G_r(f)|^2$

(color

↳ F.tr $\frac{1}{|G_r(f)|^2}$

$\left(\frac{N_0}{2}\right)$

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$C(t) * h(t) + u(t)$ ← bruit blanchi

Filtre numérique

TZ

$C(z)\ H(z) + U(z)$

(1) Zero Forçé $U(z) = 0$

↳ $C(z) H(z)$

$F(z) = \frac{1}{H(z)}$

$$F(z) = \sum_{i=0}^{N} \omega_i z^{-i}$$

pour Filtre $F(z) \times H(z) = 1$

$$\sum_{i=0}^{N} \omega_i z^{-i} \times H(z) = 1$$ ✓

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$c(t) * h(t) + u(t)$ ← bruit blanchi

Filtre numérique

TZ

$C(z)\,H(z) + U(z)$

(1) Zero Forçage $U(z)=0$

↳ $C(z)H(z)$

$F(z)=\frac{1}{H(z)}$

non dispo

$$F(z)=\sum_{i=0}^{N} w_i z^{-i}$$

pour Filtre $F(z)\times H(z)=1$

$$\sum_{i=0}^{N} w_i z^{-i} \times H(z)=1$$ ✓

(2)

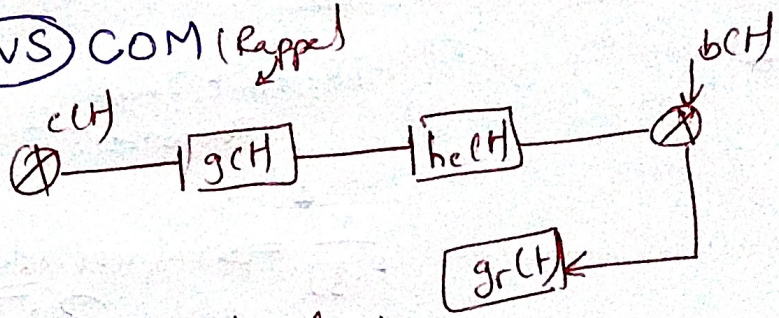
(3)

$C_k \rightarrow w_0+w_1 z^{-1}+w_2 z^{-2} \rightarrow w_0 c_k + w_1 c_{k-1} + w_2 c_{k-2} + \dots$

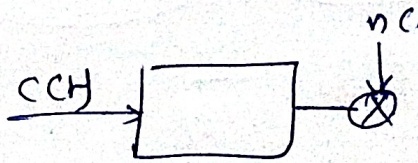
$$F(z)=\sum_{i=0}^{N} w_i z^{-i}$$

$$= w_0 + w_1 z^{-1} + w_2 z^{-2} + \dots$$

(NS) COM (Rappel)



$y(t) = c(t) * f(t) + n(t)$



↳ L'égalisation : annulation de l'effet de canal

(8)

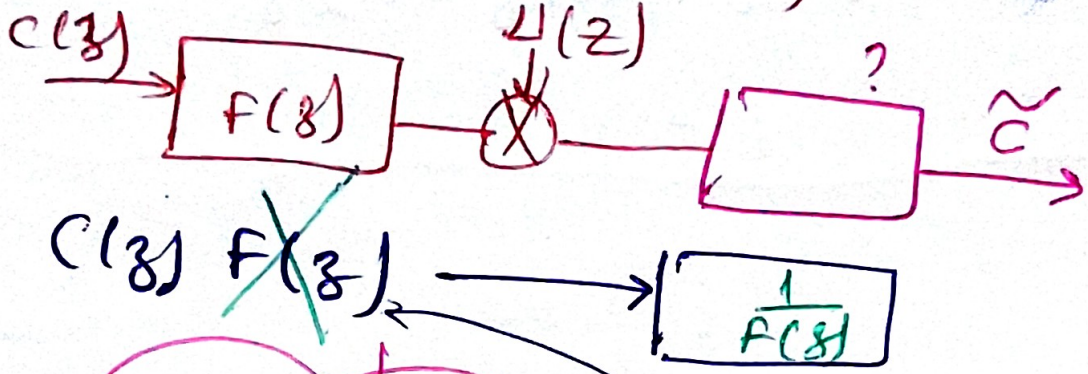
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Zero forcing (ZF : On va supposer que $\mu(n)=0$

↳ $y(n) = c(n) * f(n)$

T.Z ↓ Filtre numérique ↔ Transformé en Z

$Y(z) = C(z) F(z)$



$C(z)\,F(z)$ → $\frac{1}{F(z)}$

① stabilité

FIR : Finit Impulse Response

$\frac{1}{F(z)}$ ⇒ infinie (instable ??)

Zero forcing ⇒ $H_{ZF}(z) = \frac{1}{F(z)}$

ou $H_{ZF} = \sum_{i=0}^{N} \omega_i z^{-i}$ ⇒ $H_Z(z) = \sum_{i=0}^{N} \omega_i z^{-i} = \frac{1}{F(z)}$

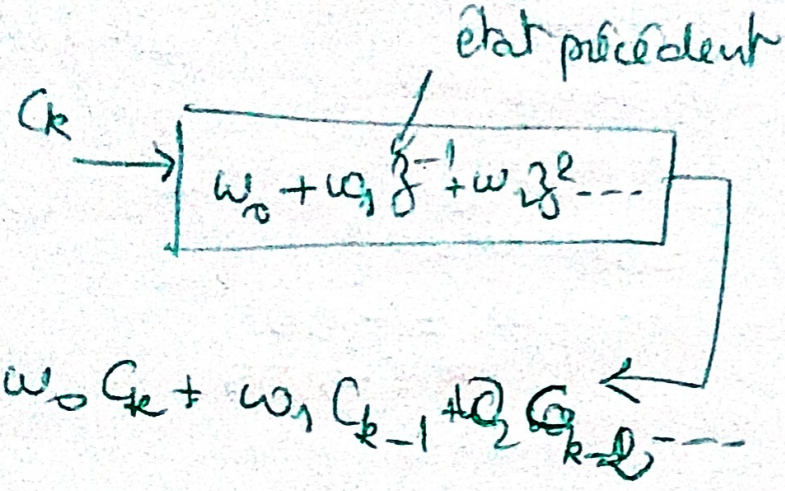
↳ ?

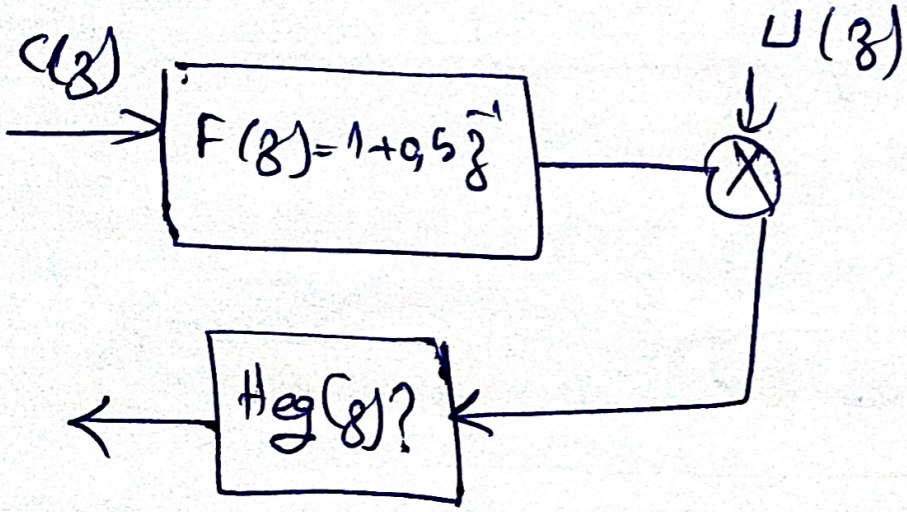
<FD $\boxed{H_{ZF}(z) \times F(z) = 1}$

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Exercice n°: (dip 21)

sortie $C_k + U_k$





1) $H_{zf}(z) = \dfrac{1}{F(z)}$ → fini infini

2) $H_{zf}(z) = \sum_{i=0} w_i z^{-i}$

$= w_0 + w_1 z^{-1} + w_2 z^{-2}$

3) $T(z) = H_{zf}(z) \times F(z) = 1$

$\Leftrightarrow H_{zf}(z) \times f(z) = 1$

$\Leftrightarrow (w_0 + w_1 z^{-1} + w_2 z^{-2}) \times (1 + 0,5 z^{-1}) = 1$ (5)

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$$w_0 + 0,5\,w_0 z^{-1} + w_1 z^{-1} + 0,5\,w_1 z^{-2} + w_2 z^{-2} + 0,5\,w_2 z^{-3} = 1$$

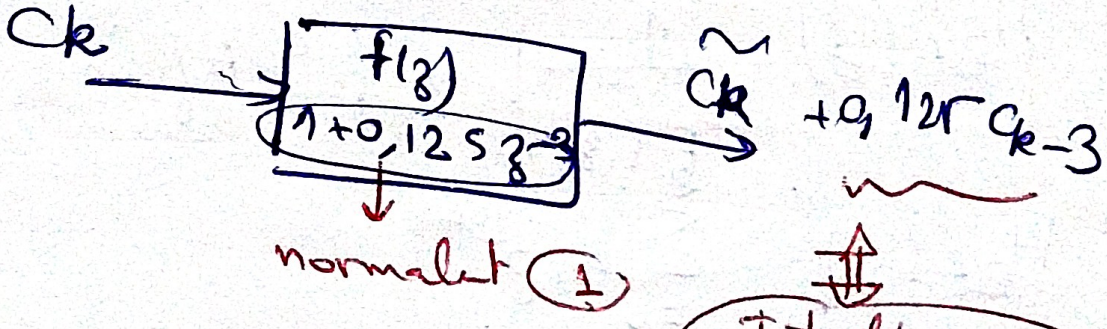
$$F(z) = w_0 + (0,5w_0 + w_1) z^{-1} + (0,5w_1 + w_2) z^{-2} + 0,5\,w_2 z^{-3} = 1$$

$$\Rightarrow \begin{cases} w_0 = 1 \\ 0,5w_0 + w_1 = 0 \\ w_1 0,5 + w_2 = 0 \end{cases} \Rightarrow \begin{cases} w_0 = 1 \\ w_1 = -0,5 \\ w_2 = 0,25 \end{cases} \quad (*)$$

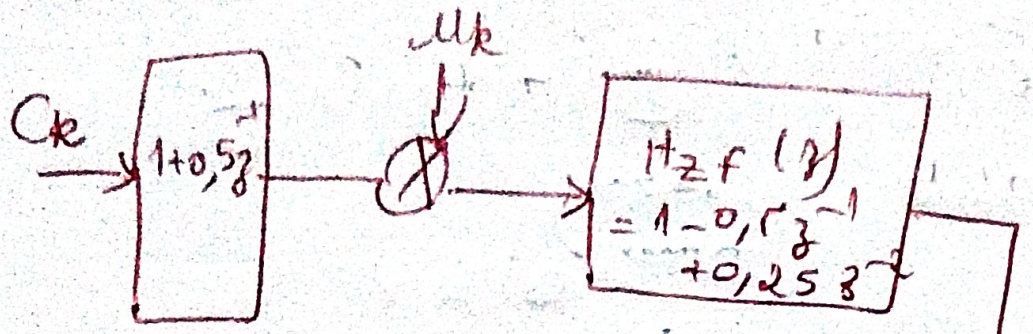
remplaçant dans $(*)$

$$F(z) = 1 + 0,5 \times 0,25\, z^{-3}$$

$$\boxed{F(z) = 1 + 0,125\, z^{-3}}$$



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$$\tilde{C}_k = C_k + 0,125C_{k-3} + u_k - 0,5u_{k-1} + 0,25u_{k-2} = \tilde{C}_k$$

trois Termes

(Signal estimé + interférence + bruit)

$$SINR = \frac{P_S}{P_B + P_{int}}$$

$$P_{interférence} = |0,125C_{k-3}|^2$$

$$= (0,125)^2 |C_{k-3}|^2$$

$$= 0,01562$$

$$P_{signal} = |C_k|^2 = 1$$

$$P_{Bruit} = |u_k - 0,5u_{k-1} + 0,25u_{k-2}|^2$$

$$= |u_k|^2 + |0,5u_{k-1}|^2 + |0,25u_{k-2}|^2$$

Tous les autres termes = 0

7

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$$P_{Brut} = \frac{N_0}{2} + (0,5)^2 \frac{N_0}{2} + (0,25)^2 \frac{N_0}{2}$$

$$= 0,065$$

signal et 4 x

$$SINR = \frac{P_S}{P_B + P_{int}}$$

$$= \frac{1}{0,065 + 0,01562}$$

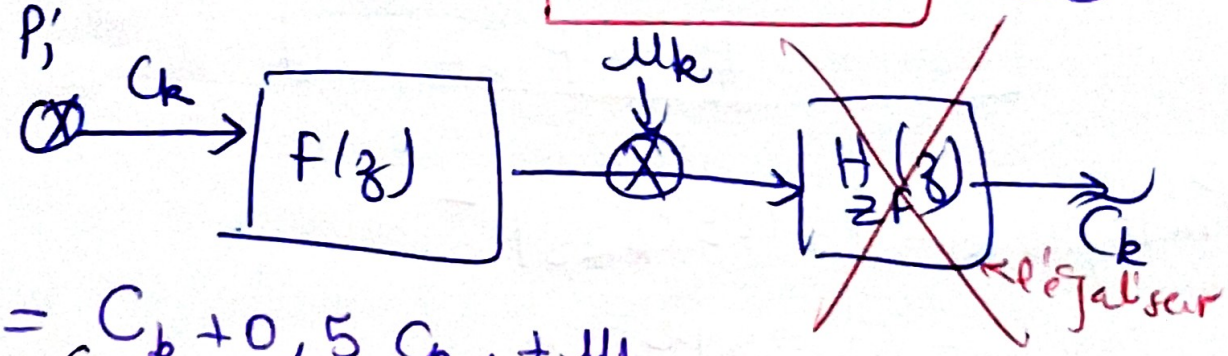
$$= 4,52 \quad \leftarrow 3,48$$

dB لازم نحولها الـ

= (حتى كان مطلوب)

$$10 \log(4,52) = 6,55 \text{ dB} \quad \leftarrow 5,41$$

7)



$$\tilde{C}_k = C_k + 0,5\, C_{k-1} + \mu_k$$

(1)² ← $(0,5)^2$ ← $\left(\frac{N_0}{2}\right)$ ← Puissance

$$SINR = \frac{1}{(0,5)^2 + 0,1} = 2,85$$

dB

$$\rightarrow 4,54 \text{ dB}$$

ex. la valeur de l'égaliseur

8

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$$\omega = R^{-1} r$$

$$= \begin{bmatrix} \text{voir} \\ \text{diap 26} \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

$$\Rightarrow \boxed{\omega = \begin{bmatrix} 0,88076 \\ -0,378 \\ 0,1400 \end{bmatrix}}$$

3) $\boxed{H_{MMSE}(z) = 0,88076 - 0,378\, z^{-1} + 0,14\, z^{-2}}$

$\Rightarrow 0,88076 - 0,378\, c_{k-1} + 0,14\, c_{k-2}$

$SINR = \dfrac{P_S}{P_B + P_{int}}$

c_k : ربتی یدتدی بدوا — et : bruit ربتی یدتدی کان H(z) ی باد

(*) $P_S = |0,88076|^2$

(**) $P_B =$ deux filtre

$F(z) \times H_{MMSE}(z)$

c_k → [ ] → sortie

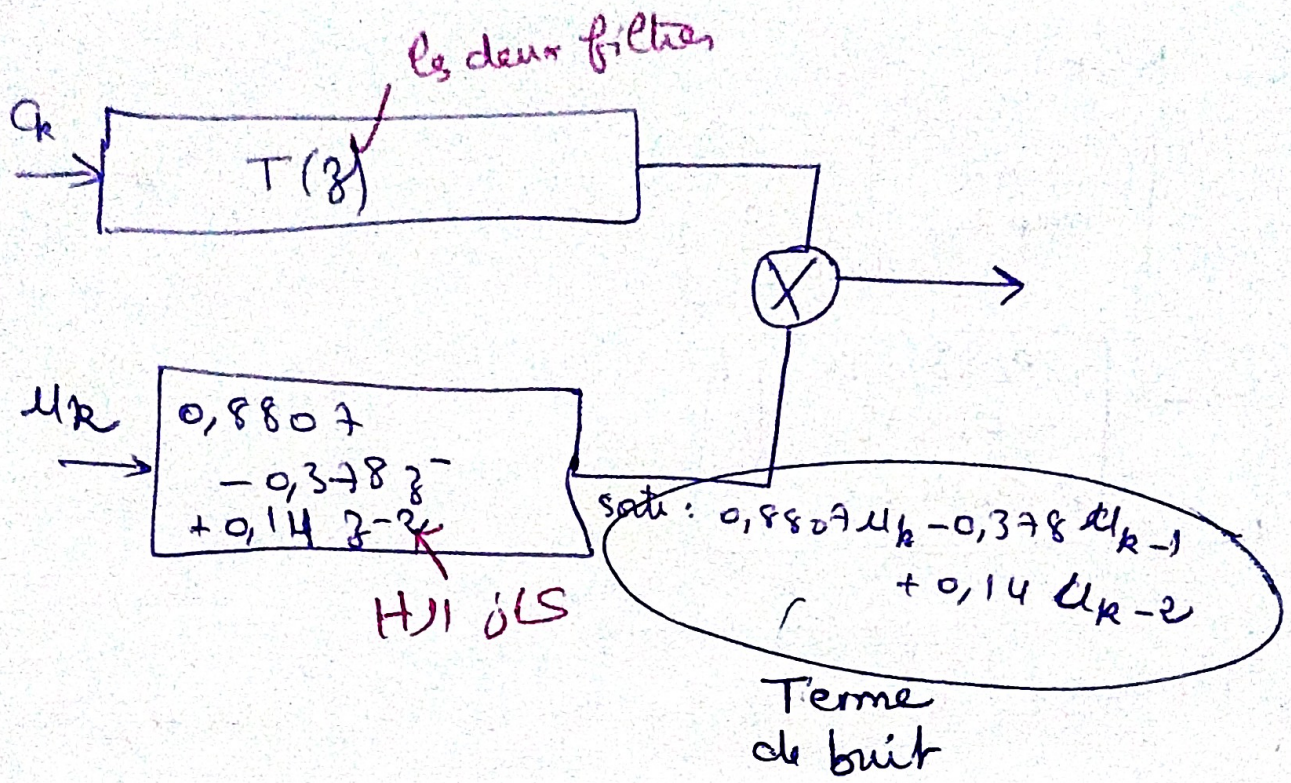
$(1 + 0,5 z^{-1})(0,88076 - 0,378 z^{-1} + 0,14 z^{-2})$

$= 0,88076 + 0,06238 z^{-1} - 0,049 z^{-2} + 0,07 z^{-3}$

$0,88076\, c_k + 0,06238\, c_{k-1} - 0,049\, c_{k-2} + 0,07\, c_{k-3}$

Terme du signal — Terme d'interférence

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$$\Rightarrow SINR = \frac{P_s}{P_{bruit} + P_{int.}}$$

$$\text{signal} = \frac{|0,880761|c_k|^2}{}$$

$$\text{bruit} \quad (0,8807)^2\frac{N_0}{2} + (0,378)^2\frac{N_0}{2} + (0,14)^2\frac{N_0}{2}$$

$$\text{int.} \quad + (0,06238)^2 + (0,049)^2 + (0,07)^2$$

$$= \quad //$$

ما قدرية
يعطي خير

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