11-12-2024

TAS/SAP TD

EXO 1 :

1) $\Delta t \Delta f \geq \frac{1}{2\pi} \Rightarrow \Delta t \geq \frac{1}{2\pi \Delta f} \Rightarrow \Delta t \geq \frac{10}{2\pi}$

$\Delta t \geq \frac{5}{2\pi}$

$\Delta t \geq 1,59$

2) we have $f_2 - f_1 = 0,35 - 0,15 = 0,2 > 0,1$

so, this window is good for observing these signals

EXO2 :

1) • figure 1 :

$$\Delta t = \frac{\text{over-all function length}}{\text{number of instanses}} = \frac{1024}{128} = \frac{2^{10}}{2^7} = 2^3 = 8s$$

turnicated intervales number = 128

• figure 2 :

$$\Delta t = \frac{1024}{16} = \frac{2^{10}}{2^4} = 2^6 = 64s$$

turnicated intervales number = 16

2) fig 1 : in $0 \leq n \leq 70 \Rightarrow$ $f = 0,1$ Hz

in $70 < n \leq 128 \Rightarrow$ $f = 0,3$ Hz

fig : in $0 \leq n \leq 6 \Rightarrow$ $f = 0,1$ Hz

in $6 \leq n \leq 16 \Rightarrow$ $f = 0,3$ Hz

c) fig 2 has the best frequancy resoltion because it has the largest time intervale

$$\Delta t\,\Delta f = \frac{1}{2\pi} \Rightarrow \Delta f = \frac{1}{2\pi \Delta t} \simeq 0{,}002\ Hz$$

Ex3

Consider a system described by the following equation :

$$y(n) = a_1\, x(n-1) + a_2 x(n-2) - b\, y(n-1)$$

1) Calculate the frequancy response
2) " the system function
3) Determine its realization structure

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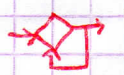
12 - 12 - 2024

SAN TD



TD4 : EX01 : $G(p) = \dfrac{3}{(p+1)(p+3)}$

1) on a $G(p) = \dfrac{3}{(p+1)(p+3)} = \dfrac{k}{\frac{p^2}{\omega_n^2} + \frac{2\varepsilon}{\omega_n}p + 1}$ et $0{,}25 \leq \omega_n T_e \leq 1{,}25$

$$= \frac{3}{p^2+4p+3} = \frac{\cancel{3}}{\cancel{3}\left(\frac{p^2}{3}+\frac{4}{3}p+1\right)} = \frac{1}{\frac{p^2}{3}+\frac{4}{3}p+1}$$

$$\Rightarrow \begin{cases} \dfrac{1}{\omega_n^2} = \dfrac{1}{3} \\ \dfrac{2\varepsilon}{\omega_n} = \dfrac{4}{3} \end{cases} \Rightarrow \begin{cases} \omega_n = \sqrt{3}\ rad/s \simeq 1{,}73\ rad/s \\ \varepsilon = \dfrac{4\omega_n}{6} = \dfrac{4\sqrt{3}}{6} \simeq 1{,}15 \end{cases}$$

alors $0{,}25 \leq \omega_n T_e \leq 1{,}25 \Rightarrow \dfrac{0{,}25\,s}{\sqrt{3}} \leq T_e \leq \dfrac{1{,}25\,s}{\sqrt{3}}$

$\Rightarrow 0{,}14\,s \leq T_e \leq 0{,}72\,s$

2) → oui on peut prendre $T_e = 0{,}2s$ car $\boxed{0{,}14s < 0{,}2s < 0{,}72s}$

1) $Gd(z) = ?$ $\quad \xrightarrow{T} \boxed{Boz} - \boxed{G(p)} - \Rightarrow - \boxed{G_d(z)}$

$$Gd(z) = (1 - z^{-1})\, \mathcal{Z}\left\{\frac{G(p)}{p}\right\} = \frac{z-1}{z}\, Z\left\{\frac{3}{p(p^2+4p+3)}\right\}$$

$$Z\left\{\frac{3}{p(p^2+4p+3)}\right\} = Z\left\{\frac{3}{p(p+1)(p+3)}\right\} = Z\left\{\frac{A}{p} + \frac{B}{p+1} + \frac{C}{p+3}\right\}$$

$$= Z\left\{\frac{A}{p}\right\} + Z\left\{\frac{B}{p+1}\right\} + Z\left\{\frac{C}{p+3}\right\}$$

ou on a : $\dfrac{ab}{p(p+a)(p+b)} \Leftrightarrow \dfrac{z}{z-1} + \dfrac{bz}{(a-b)(z-e^{-aTe})} - \dfrac{az}{(a-b)(z-e^{-bTe})}$

avec $a=1$, $b=3$

alors : $\dfrac{3}{p(p+1)(p+3)} \Leftrightarrow \dfrac{z}{z-1} - \dfrac{3z}{-2(z-e^{-Te})} + \dfrac{z}{-2(z-e^{-3Te})}$

$$\Leftrightarrow \frac{z}{z-1} + \frac{3z}{-2(z-0{,}54)} - \frac{z}{2(z-0{,}8)}$$

$$\Rightarrow G(z) = \frac{0{,}046z + 0{,}035}{z^2 - 1{,}36z + 0{,}449}$$

3) on a 2 pôle en discrèt et continue $\begin{cases} z = e^{pT_e} \\ z_1 = e^{p_1 0{,}2} = e^{-0{,}2} = 0{,}81 \\ z_2 = e^{p_2 0{,}2} = e^{-3Te} = 0{,}54 \end{cases}$

et un zéros dans discrèt $z_0 = -0{,}76$

4) la descritisation ajoute un zéro dans cette fonction de transfèrt.

5) $G(z) = \dfrac{S(z)}{E(z)} = \dfrac{0{,}046z + 0{,}035}{z^2 - 1{,}36z + 0{,}449} = \dfrac{0{,}046z^{-1} + 0{,}035z^{-2}}{1 - 1{,}36z^{-1} + 0{,}449z^{-2}}$

$\Rightarrow S(z)\left[1 - 1{,}36z^{-1} + 0{,}449z^{-2}\right] = E(z)\left[0{,}046z^{-1} + 0{,}035z^{-2}\right]$

$\Rightarrow S(z) = S(z)\cdot 1{,}36z^{-1} - 0{,}44z^{-2}S(z) + 0{,}046z^{-1}E(z) + 0{,}035z^{-2}E(z)$

$\Rightarrow s(k) = 1{,}36\, s(k-1) - 0{,}44\, s(k-2) + 0{,}046\, e(k-1) + 0{,}035\, e(k-2)$

c) fig 2 has the best frequancy resoltion because it has the largest time intervale

$$\Delta t \, \Delta f = \frac{1}{2\pi} \Rightarrow \Delta f = \frac{1}{2\pi \Delta t} \simeq 0{,}002 \text{ Hz}$$

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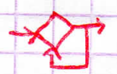
12 - 12 - 2024

SAN TD



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$$= \frac{3}{p^2 + 4p + 3} = \frac{\cancel{3}}{\cancel{3}\left(\frac{p^2}{3} + \frac{4}{3}p + 1\right)} = \frac{1}{\frac{p^2}{3} + \frac{4}{3}p + 1}$$

$$\Rightarrow \begin{cases} \frac{1}{\omega_n^2} = \frac{1}{3} \\ \frac{2\varepsilon}{\omega_n} = \frac{4}{3} \end{cases} \Rightarrow \begin{cases} \omega_n = \sqrt{3} \text{ rad/s} \simeq 1{,}73 \text{ rad/s} \\ \varepsilon = \frac{4\omega_n}{6} = \frac{4\sqrt{3}}{6} \simeq 1{,}15 \end{cases}$$

alors $0{,}25 \leq \omega_n T_e \leq 1{,}25 \Rightarrow \frac{0{,}25}{\sqrt{3}} s \leq T_e \leq \frac{1{,}25}{\sqrt{3}} s$

$\Rightarrow 0{,}14 s \leq T_e \leq 0{,}72 s$

2) → oui on peut prendre $T_e = 0{,}2 s$ car $\boxed{0{,}14 s < 0{,}2 s < 0{,}72 s}$

TP4 . EXO2 :

0) donné le schémas de système

$$BO(z) = G(z) = K\,G'(z)$$

$$G(z) = \frac{0{,}16\,K}{(z-0{,}8)^2} \qquad K>0 \ ; \ Te = 0{,}1\ s$$

1) Stabilité de système en BF :

$$BF(z) = \frac{G(z)}{1+G(z)} = \frac{0{,}16\,K}{(z-0{,}8)^2 + 0{,}16\,K} = \boxed{\frac{0{,}16\,K}{z^2 - 1{,}6\,z + 0{,}64 + 0{,}16\,K}}$$

Critère de Jury

$$D(z) = z^2 - 1{,}6\,z + [0{,}64 + 0{,}16\,K]$$

$$\begin{array}{ll} \to |a_0| < a_2 & \\ \to D(1) > 0 & \\ \to D(-1) > 0 & \end{array} \left\{ \begin{array}{ll} |0{,}16K - 0{,}64| < 1 & \ldots (1) \\ -0{,}6 + 0{,}16K - 0{,}64 > 0 & \ldots (2) \\ 2{,}6 + 0{,}16K + 0{,}64K & \ldots (3) \end{array} \right.$$

$(1) \Rightarrow K < 2{,}2$; $(2) \Rightarrow K > -0{,}2$; $(3) \Rightarrow K > -20{,}2$

et on a $K > 0$

$\Rightarrow$ si on veut un système stable $K \in]0 ; 2{,}2[$

2) $K = 1$; $\mathcal{E}(\infty) = ?$; $\qquad e(k) = u(k)$

$$\mathcal{E}(\infty) = \lim_{z\to 1} \mathcal{E}(z) = \lim_{z\to 1} \frac{z-1}{z} \frac{E(z)}{1 + FTBO}$$

$$= \lim_{z\to 1} \frac{z-1}{z} \frac{\frac{z}{z-1}}{1 + \frac{0{,}16}{(z-0{,}8)^2}} = \lim_{z\to 1} \frac{1}{1 + \frac{0{,}16}{(z-0{,}8)^2}} = \boxed{0{,}2}$$

$$\frac{S(z)}{E(z)} = G(z) = \frac{0,16}{z^2 - 1,6z + 0,8} \Rightarrow \cancel{S(z)z^2 - 1,6\,S(z)z\ldots 0,}$$

$$= \frac{0,16\,z^{-2}}{1 - 1,6z^{-1} + 0,8z^{-2}} \Rightarrow \cancel{S(z)}$$

$$\Rightarrow S(z)\,(1 - 1,6\,z^{-1} + 0,8\,z^{-2}) = E(z)\,0,16\,z^{-2}$$

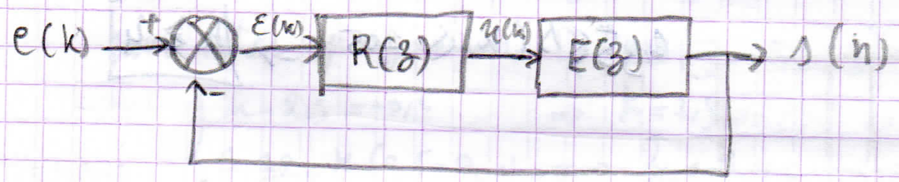
$$\Rightarrow S(z) = 1,6\,S(z)\,z^{-1} - 0,8\,S(z)\,z^{-2} + 0,16\,E(z)\,z^{-2}$$

$$\Rightarrow s(k) = 1,6\,s(k-1) - 0,8\,s(k-2) + 0,16\,e(k-2)$$

TD4 . EXO 3 :

$$H(z) = \frac{0,2\,z^{-1}}{1 - 0,8\,z^{-1}} = \frac{0,2}{z - 0,8}$$

$$R(z) = \frac{k(z - z_0)}{(z - 1)}$$



1) $D(z) = ?$; FTBF $= \dfrac{R(z)\,E(z)}{1 + R(z)\,E(z)} \Rightarrow \boxed{D(z) = 1 + R(z)\,E(z)}$

$$D(z) = 1 + R(z)\,G(z) = 1 + \frac{k(z - z_0)}{z - 1} \cdot \frac{0,2}{z - 0,8}$$

2) $D_d(z) = (z - 0,3)z = z^2 - 0,3z \quad \ldots (1)$

$$D(z) = 0 \Rightarrow (z-1)(z-0,8) + k(z - z_0)\cdot 0,2) = 0$$

$$\Rightarrow z^2 - \underbrace{(1,8 - 0,2k)}\,z + 0,8 - 0,8 - 0,2k\,z_0 = 0$$

pour (A) = (B) $\begin{cases} 1,8 - 0,2k = 0,3 \\ 0,8 - 0,2k\,z_0 = 0 \end{cases} \Rightarrow \begin{cases} k = 7,5 \\ z_0 = 0,53 \end{cases}$

$$\Rightarrow R(z) = \frac{7,5\,(z - 0,53)}{z - 1}$$

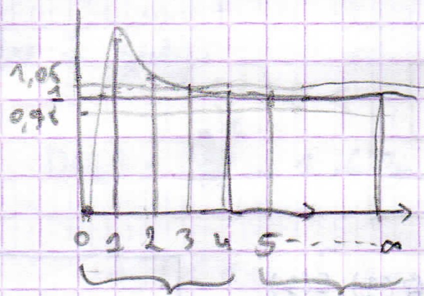
3) $FTBF(z) = \frac{R(z)\,G(z)}{1+R(z).G(z)} = \frac{1{,}5z - 0{,}79}{z^2 - 0{,}3z}$

$$\frac{S(z)}{E(z)} = \frac{1{,}5z^{-1} - 0{,}79z^{-2}}{\cancel{z} - 0{,}3z^{-1}}$$

$$s(k) = 1{,}5\,e(k-1) - 0{,}79\,e(k-2) + 0{,}3\,s(k-1)$$

$$\left.\begin{array}{l} s(0) = 0 \\ \boxed{s(1) = 2{,}5} \\ s(2) = 1{,}16 \\ s(3) = 1{,}058 \\ s(4) = 1{,}025 \end{array}\right\} \boxed{s(1)} \text{ est la plus grande valeur}$$

$$s(\infty) = \lim_{z\to 1} (1-z^{-1})\,S(z) = \lim_{z\to 1} \frac{1{,}5 - 0{,}71}{2(z-0{,}5)} = 1$$



$0{,}95 \leq s(k) \leq 1{,}05 \Rightarrow \boxed{k \geq 4}$

regime transitoire — regime permanent

commande maximal

$$R(z) = \frac{U(z)}{E(z)} \Rightarrow U(z) = R(z)\,E(z)$$

Méthode 1 : $U(0) = \lim_{z\to+\infty} U(z) = \lim_{z\to\infty} R(z)\,E(z)$ avec $E(z) = \frac{z}{z-1}$

$$= \lim_{z\to+\infty} \frac{7{,}5(z-0{,}53)}{z-1}\;\frac{z}{z-1} = \lim_{z\to+\infty} \frac{7{,}5(z-0{,}53)\,z}{(z-1)^2}$$

$$= \lim_{z\to+\infty} \frac{7{,}5\,z^2}{z^2} = 7{,}5 \Rightarrow U(0) = \boxed{7{,}5}$$

$$\Rightarrow \left\{\begin{array}{l} \text{amplitude maximal : } \boxed{1{,}5} \\ \text{temps de reponse à 5\% : } \boxed{k = 4} \\ \text{valeur maximal de commande : } \boxed{7{,}5} \end{array}\right.$$

TD$_4$. EXO4 :

$$G(z) = \frac{(1+0,5z^{-1})z^{-1}}{(1-0,7z^{-1})(1-0,6z^{-1})}$$

- Spécification

$$\begin{cases} \mathcal{E}_p(\infty) = 0 \\ \text{pôle dominant} = 0,4 \quad \text{((Les autres sont 0))} \end{cases}$$

on propose un correcteur PI $\Rightarrow R(z) = \dfrac{k(z-z_0)}{z-1}$

$$G(z) = \frac{(1+0,5z^{-1})z^{-1}}{(1-0,7z^{-1})(1-0,6z^{-1})}$$

$$= \frac{(z+0,5)\cancel{z^{-2}}}{(z-0,7)\cancel{z^{-1}}(z-0,6)\cancel{z^{-1}}} = \boxed{\frac{(z+0,5)}{(z-0,7)(z-0,6)}}$$

$$1 + R(z)G(z) = 0 \Rightarrow 1 + \frac{k(z-z_0)}{(z-1)} \frac{z+0,5}{(z-0,7)(z-0,6)} = 0 \quad (A)$$

$$(A) \Rightarrow z^3 + (k-2,3)z^2 + [1,72 + k(0,5-z_0)]z - 0,42 - 0,5kz_0 = 0$$

pour notre spécification $D_p(z) = (z-0,3)z^2$

$$\begin{cases} k - 2,3 = -0,5 & \Rightarrow k = 2,9 \\ 1,72 + k(0,5-z_0) = 0 \Rightarrow z_0 = 1,4 \\ -0,42 - 0,5kz_0 = 0 \Rightarrow \text{n'est pas possible} \end{cases}$$

$\Rightarrow$ placer les pôles dominaux et voir que ce vale se n'est pas toujours une bonne solution, et la solution est de proposer un correcteurs non standard

TD$_4$. EXO5 :

$$G(p) = \frac{1}{p+1} \qquad Te = 0,5 \quad \Rightarrow G(z) = \frac{(1+0,5z^{-1})z^{-1}}{(1-0,7z^{-1})(1-0,6z^{-1})}$$

$$R(z) = \frac{1}{B_0G(z)} \frac{1}{(z-1)^m} \frac{k_0(1+A_1z^{-1})(1+A_2z^{-1})\ldots}{(1+B_1z^{-1})\ldots}$$

$$\Rightarrow R(z) = \frac{1}{B_0G(z)} \frac{1}{z-1} \frac{k_0}{1+Bz^{-1}}$$

$$\overline{B_0G(z)} = \frac{0{,}4}{z-0{,}6}$$

$$\Rightarrow 1 + R(z)\,\overline{B_0G(z)} = 0$$

$$\Rightarrow 1 + \cancel{\frac{1}{\overline{B_0G(z)}}}\;\frac{1}{z-1}\;\frac{k_0}{(1+Bz)}\;\cancel{\overline{B_0G(z)}} = 0$$

$$\Rightarrow 1 + \frac{k_0}{(z-1)(z+Bz)} = 0 \;\Rightarrow (z-1)(z+Bz) + k_0 = 0 \;\ldots (1)$$

$$\Rightarrow z^2 - (z_1 + z_2)z + z_1 z_2 = 0 \;\ldots (B)$$

$$\Rightarrow z^2 - 2e^{-w_0T\xi}\cos(w_0T\xi)\,z + e^{-2w_0T\xi} = 0 \;\ldots (B)$$

$$\Rightarrow z^2 - 0{,}76z + 0{,}25 = 0 \;\ldots (2)$$

$(A) = (B)$

$$z^2 + z(B - 1 + k_0) - B = z^2 - 0{,}76z + 0{,}25 \qquad \begin{cases} k = 0{,}49 \\ B = -0{,}25 \end{cases}$$

$$\Rightarrow R(z) = \frac{1{,}22\,z(z-0{,}6)}{(z-1)(z-0{,}25)}$$

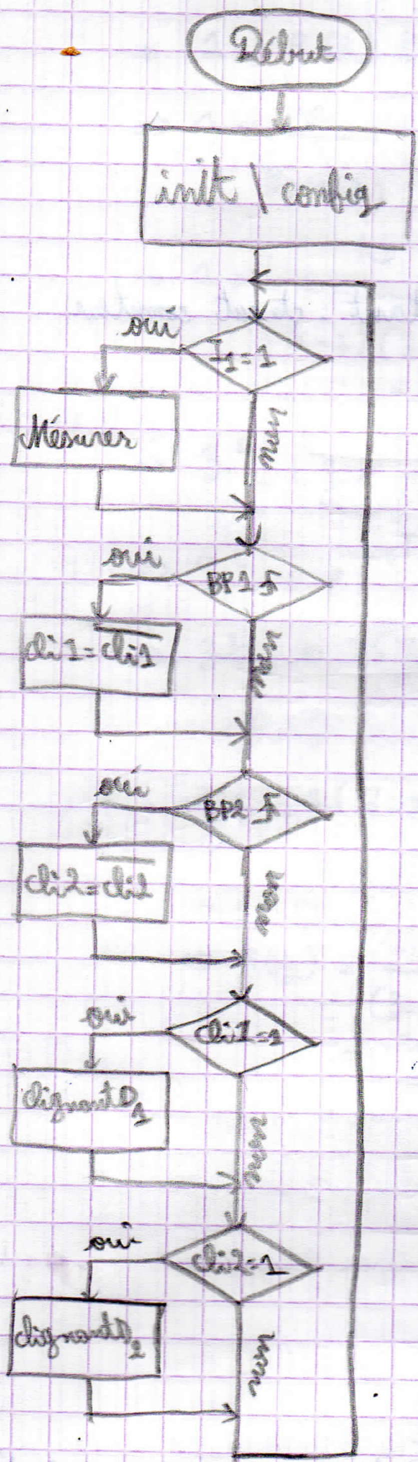
15-12-2024

SAMC TD

TD3-Exo2

```
#include <LiquidCrystal.h>
/* LCD declaration
 :
*/
byte ctcling , ctcpt , compt; // ctcling clignantant , ctcpt compteur
bool mode;
void setup(){
   PinMode (2, INPUT_PULLUP); /*
    :  lcd, pinmode
   */
   attachInterrupt (0, MACT, Rising);
   Cli();
   /*
    :  initialization Timer 1
   */
   TCNT1 = 65536 - 625;
   TIMSk1 = 1;
   Sei();
 }
 void Loop (){
   if (digitalRead(11)==0) {
      if ( ctcling >200 ){  ctcling =0; digitalWrite(12, !digitalRead (12));}
   } else { digitalWrite (12,0);}
   if( mode = =1){ if (ctcpt > 50) {compt ++; Affichage(); ctcpt=0;}}
 }
 void MACT(){ mode = !mode;}
 ISR(Timer1_OVF_vect) { ctcpt ++; ctcling++}
```

TP$_3$-Exo 3



Per = 62,5 ns × 128

$N = \frac{1ms}{per} = \boxed{125}$

Programme :

// Configuration LCD puis :

```
bool BP1, BP2, MBP1, MBP2, cli1, cli2;
unsigned long NV, vitesse, temp;
int ctcli1, ctcli2, ctmes;

Void setup(){

  // Configuration I/O puis pinMode(A0, INPUT);
                         pinMode(A3, INPUT);
  MBP1 = 1; MBP2 = 1; cli1 = 0; cli2 = 0
  ctcli1 = 0; ctcli2 = 0; cli();

  // configuration + prédiv Timer 2 puis

  TCNT2 = 256 _ 125;

  TIMSK2 = 1;

  sei();}

ISR(Timer2_OVF_vect){ TCNT2 = 256 - 125;
  ctcli1++; ctcli2++; ctmes++
}

Void loop(){ BP1 = digitalRead(2);
             BP2 = digitalRead(10);
             if(BP1 == 0 && MBP1 == 1) MBP1 = 0;
             if(BP1 == 1 && MBP1 == 0){MBP1 = 1;
             cli1 = !cli1; }

// Le même pour BP2
```

La continuité va être sur moodle

16 - 12 - 2024
TD_5 SAN

TD_5 . EXO 1 :

$$G(p) = \frac{1,11}{1 + \underbrace{0,014}_{\tau} p}$$

$$PI : R(z) = \frac{k(z - z_0)}{z - 1}$$, Spécifications en BF $\begin{cases} \omega_0 = 25 \text{ rad/s} \\ \xi = 0,7 \end{cases}$

1) $\overline{B_0 G}(z) = ?$

a_ choix de Te

système 1er ordre $\rightarrow 0,25\tau \leq T \leq \tau$ et $\tau = 0,014$

$\Rightarrow 0,0035 \leq T \leq 0,014 s$

~~on choisi la valeur minimale~~

on choisi $Te = 0,004 s$

$$\overline{B_0 G}(z) = (1 - z^{-1}) Z\left\{\frac{G(p)}{p}\right\} = \frac{z-1}{z} Z\left\{\frac{1,11}{p(1+0,14p)}\right\}$$

$$= \frac{z-1}{z} Z\left\{\frac{1,11 \cdot \frac{1}{0,014}}{p\left(\frac{1}{0,014} + p\right)}\right\} \qquad a = \frac{1}{0,014}$$

$$= \cancel{\frac{z-1}{z}}\, 1,11\, \cancel{\frac{z}{z-1}}\, \frac{1 - e^{-aTe}}{z - e^{-aTe}}$$

$$= \frac{1,11\left(1 - e^{-\frac{0,004}{0,014}}\right)}{z - 0,75} = \frac{0,28}{z - 0,75}$$

1) Equation caractéristique de système

$$1 + \overline{B_0 G}(z)\, R(z) = 0$$

$$1 + \frac{k(z - z_0)}{(z-1)} \frac{0,28}{z - 0,75} = 0$$

$$(z-1)(z-0,75) + 0,28k(z - z_0) = 0$$

$$z^2 - 1,75z + 0,75 + 0,28kz - 0,28kz_0 = 0 \quad \dots \; (1)$$

- Equation characteristique désiré

$$z^2 + \rho_1 z + \rho_2 = 0 \Rightarrow z^2 - 2e^{-\xi\omega_0 T_e}\cos(\omega_0 T_e\sqrt{1-\xi^2})z + e^{-2\xi\omega_0 T_e} = 0$$

$$\Rightarrow z^2 - 0{,}993z + 0{,}243 = 0 \quad \text{--- (2)}$$

(1) = (2)

$$\begin{cases} 1{,}75 - 0{,}28k = 0{,}993 \Rightarrow k = 2{,}70 \\ 0{,}75 - 0{,}28kz_0 = 0{,}242 \Rightarrow z_0 = 0{,}67 \end{cases}$$

$$\Rightarrow R(z) = \frac{2{,}70(z - 0{,}67)}{z-1}$$

- FTBF stable
- FTBO instable

TD5. EXO2 :

$\rho = 0{,}9$; $\omega_1 = 0{,}06$ rad/s ; $T_e = 8{,}06$ s

$$\overline{B_0G(z)} = \frac{z+0{,}58}{z^2 - 1{,}5z + 0{,}5} \ ; \ R(z) = \frac{r_2 z^2 - r_1 z + r_0}{(z-1)(z+s_1)}$$ PID filtré

$$\Rightarrow FTBF = \frac{\overline{B_0G(z)}R(z)}{1 + \overline{B_0G(z)}R(z)}$$

$$\Rightarrow 1 + \overline{B_0G(z)}R(z) = 0$$

$$\Rightarrow 1 + \frac{z+0{,}58}{z^2-1{,}5z+0{,}5}\,\frac{r_2z^2 + r_1z + r_0}{(z-1)(z+s_1)} = 0$$

$$\Rightarrow 1 + \frac{z+0{,}58}{z^2-1{,}5z+0{,}5}\,\frac{r_2(z^2 + \frac{r_1}{r_2}z + \frac{r_0}{r_2})}{(z-1)(z+s_1)} = 0$$

on pose $\begin{cases} r_1/r_2 = -1{,}5 \\ r_0/r_2 = 0{,}5 \end{cases}$

$$\Rightarrow 1 + \frac{r_2(z+0{,}58)}{(z-1)(z+s_1)} = 0 \Rightarrow \frac{(z-1)(z+s_1) + r_2(z+0{,}58)}{(z-1)(z-s_1)} = 0$$

$\Rightarrow (z-1)(z+s_1) + r_1(z+0,58) = 0$

$\Rightarrow z^2 + [s_1 - 1 + r_1] z + 0,58 r_1 - s_1 = 0$ --- (1)

Équ. charac. désiré :

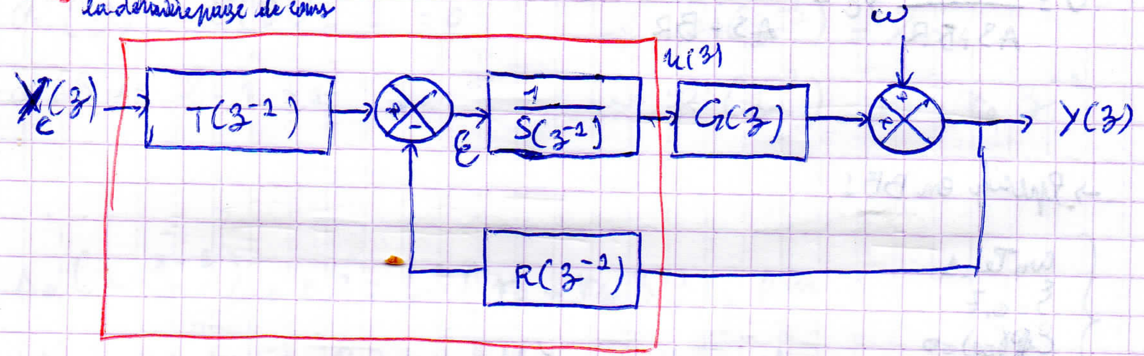
$z^2 - 1,29 z + 0,41 = 0$ --- (2)

(1) = (2)

$\begin{cases} s_1 - 1 + r_1 = -1,29 \\ 0,58 r_1 - s_1 = 0,41 \end{cases} \Rightarrow \begin{cases} r_2 = -0,07 \\ s_1 = -0,2 \end{cases} \Rightarrow \begin{cases} r_1 = 0,10 \\ r_0 = -0,03 \end{cases}$

$$\boxed{R(z) = \frac{-0,07 z^2 + 0,1 z - 0,03}{(z-1)(z-0,2)}}$$

TD + ex cours : la dernière page de cours



Correcteur RST

$G(z) = 0,37 \dfrac{z + 0,718}{(z-1)(z-0,37)} = \dfrac{B(z^{-1})}{A(z^{-1})}$

$\boxed{U(z) = \frac{1}{S}\left[T Y_c - R Y\right]}$ ... Loi de command --(4)

$Y(z) = G(z) U(z) + \omega(z)$

$FTBF = \dfrac{Y(z)}{Y_c(z)} = ?$

La page suivante →

$$Y(z) = G(z)\cdot U(z) + w(z)$$

$$= \frac{B}{A}\left[\frac{1}{S}TY_c - \frac{1}{S}RY\right] + w$$

$$= Y + \frac{BR}{AS}y = \frac{TB}{AS}y_c + w$$

$$\Rightarrow Y\left[\frac{AS+BR}{AS}\right] = \frac{TB}{AS}y_c + w$$

$$\Rightarrow Y = \frac{TB}{AS} \times \frac{AS}{AS+BR}y_c + \frac{AS}{AS+BR}w$$

$$\boxed{Y = \frac{BT}{AS+BR}y_c + \frac{AS}{AS+BR}w}$$

de (1) on a

$$\circ\ US = TY_c - Ry = Ty_c - R\left[\frac{B}{A}U + w\right]$$

$$U = \frac{AT}{AS+BR}y_c - \frac{AR}{AS+BR}w$$

→ Specif en BF :

- $w_n T_e = 1$
- $\xi = 0{,}7$
- $\mathcal{E}_p(\infty) = 0$
- Rejet de perturbation de type échelon

→ Synthèse du RST ;

$$G(z^{-1}) = 0{,}37\ \frac{z^{-1}(1-0{,}718z^{-2})}{(1-z^{-1})(1-0{,}37z^{-2})}$$

① Factorisation :

$$B = B^- B^+ \Rightarrow B^- = 0{,}37z^{-1} \ ; B^+ = 1+0{,}718z^{-1}$$

$$A = A^- A^+ \Rightarrow A^- = 1-z^{-1} \ ; A^+ = 1-0{,}37z^{-1}$$

$$H_m(z^{-1}) = \frac{B_m(z^{-1})}{A_m(z^{-1})}$$

$$B_m(z^{-1}) = \frac{B^-\cdot B'_m}{A_m}$$

* $A_m = 1 - 0{,}7497\, z^{-1} + 0{,}24323\, z^{-2}$

⊛ $R(z)$? , $S(z) = ?$

$S(z^{-1}) = B^+ S'(z^{-1})$;

$R(z^{-1}) = A^+ R'(z^{-1})$

$S'(z^{-1}) \Rightarrow$ sans intégrateur car $G(z)$ possède un intégrateur

⊛ Équation de Bézout

$A^- S' + B^- R' = A_m A_0$

$A_0(z^{-1}) = 1$
car il n'y a pas spécification

$d°(A^-) = 1$, $d°(B^-) = 1$

$d°(A_m A_0) = 2$

$\underset{1}{d°(A^-)} + \underset{1}{d°(B^-)} \leq \underset{2}{d°(A_m A_0)}$ equation non régit

$d°(S') = d°(B^-) - 1 = 0$ $\Rightarrow S'(z^{-1}) = s_0$

$d(R') = 2 - 1 = 1$ $\Rightarrow R'(z^{-1}) = r_0 + r_1 z^{-1}$

$\Rightarrow s_0(1 - z^{-1}) + 0{,}37\, z^{-1}(r_0 + r_1 z^{-1}) = A_m$

$$\begin{cases} 1 - 0{,}37\, r_0 = 0{,}7497 \\ s_0 = 1 \\ 0{,}37\, r_1 = 0{,}2422 \end{cases}$$

$\Rightarrow s_0 = 1$

$\Rightarrow r_0 = 0{,}6\cancel{7}64$

$\Rightarrow r_1 = 0{,}6\cancel{5}72$

* B'_m ?

$$H_m(1) = \frac{B^-(1)\, B'_m}{A_m(1)} = 1 \Rightarrow B'_m = \frac{A_m(1)}{B^-(1)} = 1{,}333$$

$T(z^{-1}) = ?$

$T = A^+ B'_m A_0 \Rightarrow T = (1 + 0{,}377\, z^{-1})\, 1{,}333 \times 1$

$$\begin{cases} R(z^{-1}) = (1 - 0{,}37z^{-1})(0{,}6764 + 0{,}6472z^{-1}) \\ S(z^{-1}) = 1 + 0{,}718z^{-1} \\ T(z^{-1}) = 1{,}333(1 - 0{,}37z^{-1}) \end{cases}$$

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18 - 12 - 2024

SAP - TAS TD

1) a. $\text{Rect}(f) = \dfrac{\sin(\pi f N)}{\sin(\pi f)}$

b. $\text{Rect}(f) = 0 \Rightarrow \sin(\pi f N) = 0 \; ; \; f \neq 0$

$\Rightarrow \pi f N = \pi k$

$\Rightarrow f = \dfrac{k}{N} \; ; \; k \in [-N+1 ; N-1] \cap \mathbb{Z}^*$

2) a) $N = \lim\limits_{f \to 0} \text{Rect}(f) = \dfrac{\pi f N}{\pi f} = N = \boxed{17}$

b) the width of the main lobe is $\boxed{\dfrac{2}{N}}$

c) $B = \dfrac{5}{N} - \dfrac{4}{N} = \boxed{\dfrac{1}{N}} \; ; \; f_c = \dfrac{\frac{5}{N} + \frac{4}{N}}{2} = \boxed{\dfrac{4{,}5}{N}}$

— o —

$y(n) = a_1 x(n-1) + a_2 x(n-2) - b y(n-1)$

$Y(z) = a_1 z^{-1} X(z) + a_2 z^{-2} X(z) - b z^{-1} Y(z)$

$H(z) = \dfrac{Y(z)}{X(z)} = \dfrac{a_1 z^{-1} + a_2 z^{-2}}{1 + b z^{-1}} = H_1(z) \cdot H_2(z)$