Teoria sistemelor 11.11.2024

(laborator 7 - S7)

3/6 laborator 3

$$H_{PC}(s) = \frac{2}{s^3+4s^2+5s+2}$$

a) $H_R(s) = H_{RG}(s) = k$

$$H_0 = H_{RG} \cdot H_{PC} = \frac{2k}{s^3+4s^2+5s+2}$$

$$H_w(s) = \frac{H_0}{1+H_0} = \frac{\frac{2k}{s^3+4s^2+5s+2}}{1+\frac{2k}{s^3+4s^2+5s+2}}$$

$$\Delta(s) = 1 + \frac{2k}{s^3+4s^2+5s+2} = \frac{s^3+4s^2+5s+2k+2}{s^3+4s^2+5s+2} = 0 \quad (1+H_0)$$

$$\Rightarrow s^3+4s^2+5s+2k+2 = 0$$

$a_3 = 1 > 0$ $\quad a_2 = 4 > 0$ $\quad a_1 = 5 > 0$ $\quad a_0 = 2(k+1) > 0$

$k+1>0$

$k > -1 \Rightarrow k \in (-1, \infty)$

$$H = \begin{bmatrix} 4 & 2k+2 & 0 \\ 1 & 5 & 0 \\ 0 & 4 & 2k+2 \end{bmatrix}$$

$\delta_1 = 4 > 0$

$$\delta_2 = \begin{vmatrix} 4 & 2k+2 \\ 1 & 5 \end{vmatrix} = 20 - 2k - 2 = 18 - 2k > 0$$

$18 > 2k$

$9 > k$

$\Rightarrow k \in (-1, 9)$

$\delta_3 = 40k + 40 - 4k^2 - 8k - 4 = 4(-k^2+8k+9) > 0$

$\Delta = 64 + 36 = 100$

$$k_{1,2} = \frac{-8 \pm 10}{2} \quad \begin{cases} k_1 = 9 \\ k_2 = -1 \end{cases}$$

$$\Rightarrow k \in (-1, 9)$$

b) $H_R(s) = k_p + \dfrac{k_i}{s}$ avem -> PI

$$\boxed{H_{RG-PI}(s) = \frac{k_R}{s \cdot T_R}(1 + s \cdot T_R)}$$ în plus?

$$H_0 = H_{PC} \cdot H_R$$

$$H_w(s) = \frac{H_0}{1 + H_0}$$

$$\Delta(s) = 1 + H_0 = 1 + \frac{2}{s^3 + 4s^2 + 5s + 2} \cdot \left(k_p + \frac{k_i}{s}\right) =$$

$$= \frac{s^3 + 4s^2 + 5s + 2 + \dfrac{2k_p \cdot s + k_i}{s}}{s^3 + 4s^2 + 5s + 2} = 0$$

$$\Rightarrow s^4 + 4s^3 + 5s^2 + s(2 + 2k_p) + 2k_i = 0$$

$a_4 = 1 > 0$ $\quad a_3 = 4 > 0$ $\quad a_2 = 5 > 0$ $\quad a_1 = 2 + 2k_p > 0$, $k_p > -1$ $\quad a_0 = 2k_i$, $k_i > 0$

$$H_4 = \begin{bmatrix} 4 & 2 + 2k_p & 0 & 0 \\ 1 & 5 & 2k_i & 0 \\ 0 & 4 & 2 + 2k_p & 0 \\ 0 & 1 & 5 & 2k_i \end{bmatrix}$$

$$\delta_1 = 4 > 0$$

$$\delta_2 = 20 - 2 - 2k_p = 18 - 2k_p > 0 \Rightarrow k_p < 9$$

$$\delta_3 = -k_p^2 + 8k_p + 9 - 8k_i > 0 \qquad \overline{(k_p + 1)(k_p - 9)}^{<0} < \underline{-8k_i}_{<0}$$

$\Rightarrow k_{p+1} > 0$

$k_p > -1 \Rightarrow k_p \in (-1, 9)$

$\delta_4 = 2 k_i \cdot \delta_3 > 0$

$\Rightarrow$ pt. $\begin{cases} k_p \in (-1, 9) \\ k_i \in (0, \infty) \end{cases}$ SRA - stabil

Timp discret

$\Delta(z) = a_m z^m + a_{m-1} z^{m-1} + \ldots + a_1 z + a_0$

$\begin{cases} a_m > 0 \\ (m+1) \text{ condiții trebuie îndeplinite} \end{cases}$

Condiții

(1) $\Delta(1) > 0$

(2) $\Delta(-1) > 0 \rightarrow$ pt. m - par

$\Delta(-1) < 0 \rightarrow$ pt m - impar

(3) $|a_0| < a_m \longrightarrow$ de obicei se termină aici

(4) $|b_0| > |b_{m-1}|$

	z^0	z^1	$\ldots$	z^{m-1}	z^m
1	a_0	a_1		a_{m-1}	a_m
2	a_m	a_{m-1}		a_1	a_0
3	b_0	b_1		b_{m-1}	-
4	b_{m-1}	b_{m-2}		b_0	-

$b_k = \begin{vmatrix} a_0 & a_{m-k} \\ a_m & a_k \end{vmatrix}$

După ce scriem matricea Jury $\longrightarrow$ cond (4)

Dacă este îndeplinită condiția $\longrightarrow$ sistem stabil

$\Delta = 1 + H_0$ ec caracteristică

$\hookrightarrow$ ec. caracteristică este la numitor