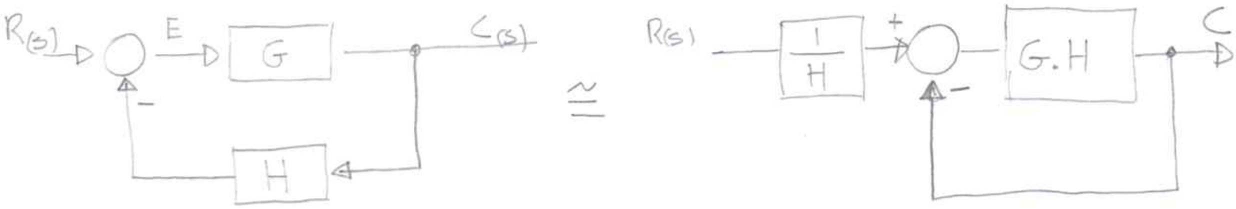
therory

teorema do valor inicial

$$x(0) = \lim_{t \to 0} x(t) = \lim_{s \to \infty} s \times X(s)$$

teorema do valor final

$$x(\infty) = x_{ss} = \lim_{t \to \infty} x(t) = \lim_{s \to 0} s \times X(s)$$



$$C = \frac{G}{1+GH} \times R \qquad C = \frac{1}{H} \cdot \frac{GH}{1+GH} \times R$$

$$C(\infty) = \lim_{s \to 0} s \cdot \frac{G}{1+GH} \cdot R(s)$$

degrau $\rightarrow \frac{1}{S}$

rampa $\rightarrow \frac{1}{S^2}$

parabola $\rightarrow \frac{1}{S^3}$

Se erro (em vez de C)

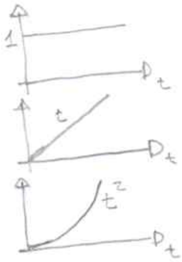
$$E = \frac{1}{G} \times \frac{G}{1+GH} \times R = \frac{1}{1+GH} \times R$$

<u>theory</u>

$$\lim_{s\to 0} s\cdot\frac{G}{1+G.1}\cdot R_{(s)} = C_{ss} = C(\infty), \quad H=1$$

$$\lim_{s\to 0} s\cdot\frac{1}{1+G.1}\cdot R(s) = e_{ss}, \quad H=1$$

input
$$\begin{cases} R(s)=\frac{1}{s} & \text{step} \\ R(s)=\frac{1}{s^2} & \text{Ramp} \\ R(s)=\frac{1}{s^3} & \text{Parabola} \end{cases}$$



—//—

$$G(s) = K\,\frac{1+b_1 s+\ldots+b_n s^n}{s^b(1+a_1 s+\ldots+a_n s^n)}$$

system type
$$\begin{cases} b=0 \\ b=1 \\ b=2 \end{cases}$$

$$e_{ss} = \lim_{s\to 0} s\cdot\frac{1}{1+K\cdot\frac{1+b_1 s+\ldots+\ldots}{s^b(1+a_1 s+\ldots+\ldots)}}\cdot\begin{Bmatrix}\frac{1}{s}\\ \frac{1}{s^2}\\ \frac{1}{s^3}\end{Bmatrix}$$

- step and $b=\emptyset$ $\quad e_{ss} = \lim_{s\to 0} \cancel{s}\cdot\frac{1}{1+K\frac{1}{1}}\cdot\frac{1}{\cancel{s}} = \frac{1}{1+\underset{K_p}{K}}$
- step and $b=1$ $\quad e_{ss} = \lim_{s\to 0} \cancel{s}\cdot\frac{1}{1+K\frac{1}{s}}\cdot\frac{1}{\cancel{s}} = \emptyset$
- Ramp and $b=0$ $\quad e_{ss} = \lim_{s\to 0} \cancel{s}\cdot\frac{1}{1+K\frac{1}{1}}\,\frac{1}{s^{\cancel{2}}} = \infty$
- Ramp and $b=1$ $\quad e_{ss} = \lim_{s\to 0} \cancel{s}\cdot\frac{1}{1+K\frac{1}{s}}\cdot\frac{1}{s^{\cancel{2}}} = \frac{1}{\underset{K_v}{K}}$

K_p → gain of position
K_v → gain of velocity $\quad$ use table
e_{ss} → error steady state

theory

Tesis T 25/3/2020

$$\lim_{s\to 0} 7\,\frac{4+3s}{5+2s+6s^2} = 7\,\frac{4+0}{5+0+0} = 7\,\frac{4}{5}$$

better method (trick) →

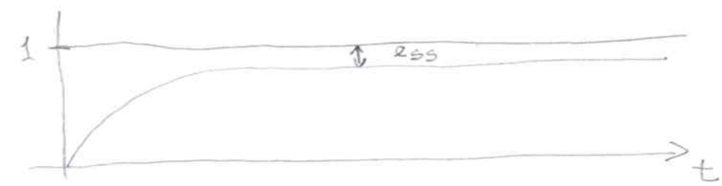
$$\lim_{s\to 0} 7\,\frac{4\left(1+\frac{3}{4}s\right)}{5\left(1+\frac{2}{5}s+\frac{6}{5}s^2\right)} = 7\,\frac{4}{5}$$

K_B

$R(s) = \frac{1}{s}$

Bode
2

degrau unitário



O erro é o afastamento do valor de entrada em situação de estabilidade.

e_{ss} - erro steady state

$e_{ss} = \frac{1}{1+K}$ → step

$\uparrow K \Rightarrow \downarrow e_{ss}$

Se sinal de entrada é o degrau unitário, sua amplitude é 1 (um), portanto o desvio deste valor é o e_{ss}.

FTMF → K_B $K_B - 1 = e_{ss}$
⇔ $R(s) = \frac{1}{s}$

FTMA → FTLG → K_p → e_{ss}
K_v → e_{ss}
K_a → e_{ss}