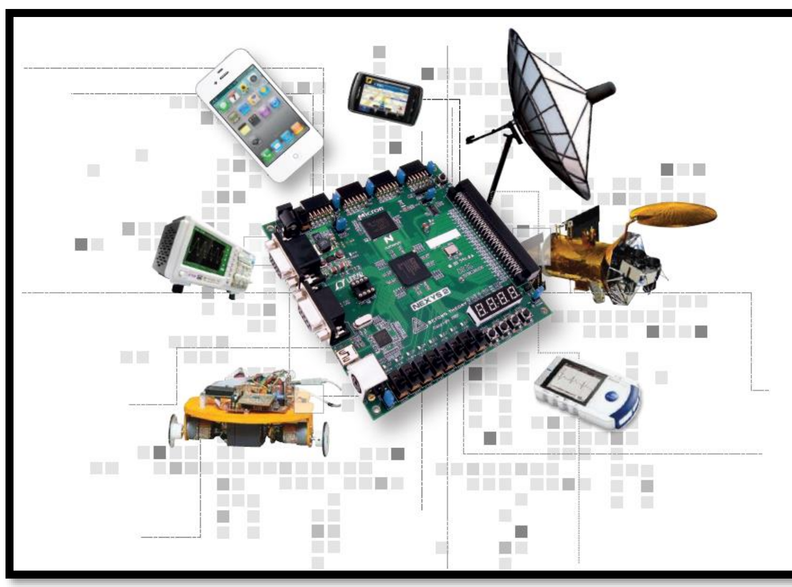
18-3-2024

Tarea 6

Sistemas embebidos



ANDRADE SALAZAR, IGNACIO
CENTRO UNIVERSITARIO DE LOS VALLES

Colocación de polos

Sintonización de Controladores PID
Método de Colocación de Polos

Planta	Acciones de control	Controlador	Polinomios	Modelo de Referencia	Ganancias
$\frac{b}{s}$	Proporcional	k_p	$F(s) = k_p$ $G(s) = 1$ $B(s) = b$ $A(s) = s$	$s + a_{m1}$	$k_p = \frac{a_{m1}}{b}$
$\frac{b}{s+a}$	Proporcional, Integral	$\frac{k_p s + k_i}{s}$	$F(s) = k_p s + k_i$ $G(s) = s$ $B(s) = b$ $A(s) = s + a$	$s^2 + a_{m1}s + a_{m2}$	$k_p = \frac{a_{m1} - a}{b}; k_i = \frac{a_{m2}}{b}$
$\frac{b}{s(s+a)}$	Proporcional, Derivativa	$k_d s + k_p$	$F(s) = k_d s + k_p$ $G(s) = 1$ $B(s) = b$ $A(s) = s^2 + as$	$s^2 + a_{m1}s + a_{m2}$	$k_d = \frac{a_{m1} - a}{b}; k_p = \frac{a_{m2}}{b}$
$\frac{b}{s^2 + a_1 s + a_2}$	Proporcional, Integral, Derivativa	$\frac{k_d s^2 + k_p s + k_i}{s}$	$F(s) = k_d s^2 + k_p s + k_i$ $G(s) = s$ $B(s) = b$ $A(s) = s^2 + a_1 s + a_2$	$s^3 + a_{m1}s^2 + a_{m2}s + a_{m3}$	$k_d = \frac{a_{m1} - a_1}{b}; k_p = \frac{a_{m2} - a_2}{b}; k_i = \frac{a_{m3}}{b}$

Estructura de la planta	Acciones de Control
$\frac{b}{s}$	proporcional
$\frac{b}{s+a}$	proporcional Integral
$\frac{b}{s(s+a)}$	proporcional Derivativa
$\frac{b}{s^2+a_1s+a_2}$	proporcional Integral Derivativa
$\frac{b_0s+b_1}{s^2+a_1s+a_2}$	proporcional Integral Derivativa No son suficientes

Controlador $G_1(s) = \frac{F(s)}{G(s)}$

Planta $G_2(s) = \frac{B(s)}{A(s)}$

Método de Colocación de polos

(Diseño de Controladores)

$$\frac{G_1(s)\,G_2(s)}{1+G_1(s)\,G_2(s)}$$

$$\frac{\frac{B(s)}{A(s)}\cdot\frac{F(s)}{G(s)}}{\frac{A(s)G(s)}{A(s)G(s)}+\frac{B(s)}{A(s)}\cdot\frac{F(s)}{G(s)}}=\frac{Y(s)}{R(s)}$$

$$\frac{Y(s)}{R(s)}=\frac{\frac{B(s)F(s)}{\cancel{A(s)G(s)}}}{\frac{A(s)G(s)+B(s)F(s)}{\cancel{A(s)\;G(s)}}}$$

$$\frac{Y(s)}{R(s)}=\frac{B(s)F(s)}{A(s)G(s)+B(s)F(s)}$$

Función de transferencia par $\frac{b}{s+a}$

$$PI = K_p + \frac{K_i}{s} = \frac{U(s)}{E(s)}$$

$$\frac{U(s)}{E(s)} = K_p \frac{s}{s} + \frac{K_i}{s} = \frac{K_p s + K_i}{s} = \frac{F(s)}{G(s)}$$

Entonces

$F(s) = K_p s + k_i$

$G(s) = s$

$B(s) = b$

$A(s) = s + a$

$$\frac{b \cdot (K_p s + K_i)}{(s+a) \cdot s + b \cdot (K_p s + K_i)} = \frac{K_p b s + K_i b}{s^2 + sa + K_p b s + K_i b}$$

$$= \frac{Y(s)}{R(s)} = \frac{K_p b s + K_i b}{s^2 + (a + K_p b) s + K_i b}$$

¿Se incremento el orden del sistema? si
¿Cuál será el valor final? 1
¿Es posible establecer el polinomio denominador completo a las acciones de control sugeridas? si

Para b/s

$$P = K_p = \frac{U(s)}{E(s)} = \frac{F(s)}{G(s)}$$

P1: NO

P2: 1

P3: Si

Entonces

$F(s) = K_p \qquad G(s) = 1$

$B(s) = b \qquad A(s) = s$

$$\frac{b \cdot K_p}{s \cdot 1 + b \cdot K_p} = \frac{K_p b}{s + K_p b} = \frac{Y(s)}{R(s)}$$

Para $b/s(s+a)$

$$PD = K_p + K_d s = \frac{U(s)}{E(s)}$$

Entonces

$F(s) = K_p + K_d s \qquad G(s) = 1$

$B(s) = b \qquad A(s) = s(s+a)$

$$\frac{b \cdot (K_p + K_d s)}{s(s+a) \cdot \overset{1}{\cancel{K_p + K_d s}} + b \cdot (K_p + K_d s)}$$

$$\frac{K_p b + K_d b s}{s^2 + a s + b K_p + K_d b s} =$$

P_1: si

$$\frac{Y(s)}{R(s)} = \frac{K_p b + K_d b s}{s^2 + (a + K_d b)s + K_p b}$$

P_2: 1

P_3: si

para $b / s^2 + a_1 s + a_2$

$$PID = K_p + K_d s + \frac{K_i}{s} = \frac{K_p s + K_d s^2 + K_i}{s}$$

Entonces

$F(s) = K_d s^2 + K_p s + K_i \qquad G(s) = s$

$B(s) = b \qquad A(s) = s^2 + a_1 s + a_2$

$$\frac{b \cdot (K_d s^2 + K_p s + K_i)}{(s^2 + a_1 s + a_2)s + b \cdot (K_d s^2 + K_p s + K_i)} =$$

P_1: si

$$\frac{K_d b s^2 + K_p b s + K_i b}{s^3 + a_1 s^2 + a_2 s + K_d b s^2 + K_p b s + K_i b}$$

P_2: 1

P_3: si

$$\frac{Y(s)}{R(s)} = \frac{K_d b s^2 + K_p b s + K_i b}{s^3 + (a_1 + K_d b)s^2 + (a_2 + K_p b)s + K_i b}$$

$K_p b = a_{m1}$ m_n: modelo de referencia

$K_p = \frac{a_{m1}}{b}$

$$s^2 + (a + K_p b)s + K_i b = s^2 + a_{m1} s + a_{m2}$$

para $b / s+a$

$a + K_p b = a_{m1}$

$K_i b = a_{m2}$

$K_p = \frac{a_{m1} - a}{b}$

$K_i = \frac{a_{m2}}{b}$

para $\frac{b}{s}$

$s + K_p b = s + a_{m1}$

$K_p b = a_{m1}$

$K_p = \frac{a_{m1}}{b}$

Para $b / s(s+a)$

$$s^2 + (a + K_d b)s + K_p b = s^2 + a_{m1} s + a_{m2}$$

$a + K_d b = a_{m1}$

$K_p b = a_{m2}$

$K_d = \frac{a_{m1} - a}{b}$ $K_p = \frac{a_{m2}}{b}$

para $\frac{b}{s^2+a_1 s+a_2}$

$$s^3+(a_1+K_d b)s^2+(a_2 K_p b)s+K_i b =$$

$$s^3+a_{m1}s^2+a_{m2}s+a_{m3}$$

$$a_1+K_d b = a_{m1}$$

$$a_2+K_p b = a_{m2}$$

$$K_i b = a_{m3}$$

$$K_d = \frac{a_{m1}-a_1}{b}$$

$$K_p = \frac{a_{m2}-a_2}{b}$$

$$K_i = \frac{a_{m3}}{b}$$