MEEC, Maero

Control Computer

2016/2017

first Test

November 9, 2016, 20 hours - V1.16 rooms, v1.15, v1.14, V1.12

Quotation: P1a) 1b), 2c) 1d) 1e) 1f) 1 P2a) 3b) 1c) 1d) P3a 1) 3b) P4a 1) 1b), 1c) 1

Duration: 2 hours. Not any elements of consultation is allowed.

P1. In a given case the manipulated variable • and output are related

the following transfer function

$$\bullet(\bullet) = \frac{1}{\bullet + 0.5}\,\bullet(\bullet)$$

a) Write a difference equation relating the samples • with of the •.

b) Taking as an initial condition • (0) = 0, use the difference equation to calculate • (•) When • = 1, ..., 5, suposing that • (•) = 1, • ≥ 0.

c) Under the conditions of b), to determine the exact value $\bar{\bullet}$ whose • (•) if when approaching • tends to infinity.

d) In order to control the process, causing the output • Have a next value of the reference •, o processo é ligado a um controlador integral tal como se mostra na figura P1-1. Determine a função de transferência do sistema em cadeia fechada, •(•)/•(•).

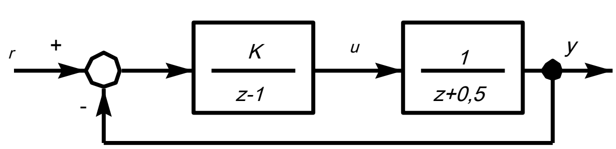

Fig. P1-1. Problema P1. Interligação entre o processo e o controlador.

e) Mostre que se o sistema em cadeia fechada for estável, e se a referência

• for constante, então quando • tende para infinito, •(•) tende para o valor da referência •.

f) Diga se o sistema realimentado é estável para • = 0,52. Justifique.

P2. Um sistema contínuo com função de transferência

$$•(•) = \frac{• + 1}{• + 2}$$

é amostrado com um D/A e um A/D, com um intervalo de amostragem h (considere um valor genérico h > 0).

a) Obtenha a função de transferência discreta equivalente (em função de h).

b) Diga justificando qual a gama de valores de h que garante que a função discrete transfer that has not got zeros outside the circle unit.

c) Tell justifying the choice h = 1 It is adequate.

d) write the equations of state for performing the function of discrete transfer.

Help: 1,(• 0) • *for Z* —— *ZZK*1 *Zand* $^{kh\,T}$ • • $\frac{z}{•\ ez^{hT}}$ $\mathscr{L}$(• -••) = 1 • + •

P3. Consider a system modeled by the difference equation:

( ) • • •1 ( ) *y ty TVT* •1 ( ) • *bu* (P2-1)

on what • is a zero mean noise signal. an experiment is performed in system to collect data in order to estimate the parameters *The* and *B .* With data obtained for *u* and *y* The following quantities were calculated:

$\sum_{i•1}^{999}$ ^{2} *iy*•1 ( ) • 30 $\sum_{i•1}^{999}$ ^{2} *iu*•1 ( ) • 50 $\sum_{i•1}^{999}$ ( ) *iyiy* ( ) • 1

$\sum_{i•1}^{999}$ •1 ( ) *iuiy* ( ) • 20 $\sum_{i•1}^{999}$ ( ) *iuiy* ( ) • 36

a) Determine the estimated least squares parameter *The* and *B .*

Present intermediate calculations.

b) Suppose that • (•) = • (•) + •• (• - 1). Explain the minimum algorithm

square extended to estimate •, • and •. Write the equations

define the algorithm but no the need to apply for

estimates.

P4. The temperature • a heat accumulator for heating water

satisfies the following difference equation

$$• (• + 1) = α• (•) + (1 - α) •$$

on what • It is a constant and α is a constant parameter which verifies 0 <α <1.

a) Determine the value of the equilibrium temperature (ie, a value

temperature such that if the initial condition is equal to it, so

temperature always remains constant) $\bar{•}$ in function of α and •.

b) Suppose that the initial state is not stable temperature.

Obtain a difference equation for the deviation

$$• (•) = • (•) - \bar{•}$$

w) Without use the concept of pole nor the transformed Z, show that • (•)

tends to zero when • tends to infinity, meaning that the balance $\bar{•}$ It is

asymptotically stable.