Practice Examples

MATLAB Approach for Obtaining Step, Impulse and Frequency Responses of Discrete-time Systems

Objective

This practice examples aims to teach the students to use MATLAB to obtain responses of discrete-time control systems to different input signals – unite step, impulse and sinusoidal.

Background Materials

Lecture notes for the course Control Theory 2, Theme 3. Z Plane Analysis of Discrete-Time Control Systems,

Examples

Example # 1

Determine the step response of the discrete-time unity-feedback closed-loop system, if the pulse transfer function of the open-loop system is:

$$G(z) = \frac{0,0234z + 0,022}{z^2 - 1,8187z + 0,8187}, T_0 = 0.2\sec,$$

Example # 2

Determine the step response of the discrete-time control system, shown in Figure 1, for three values of the sample period $T_0 = 0.007\sec., T_0 = 0.01\sec.$ and $T_0 = 0.002\sec.$

$$G(s) = \frac{k(T_3 s + 1)}{(T_1 s + 1)(T_2 s + 1)}, k = 16, T_1 = 0.1\sec., T_2 = 0.46\sec., T_3 = 0.58\sec.$$
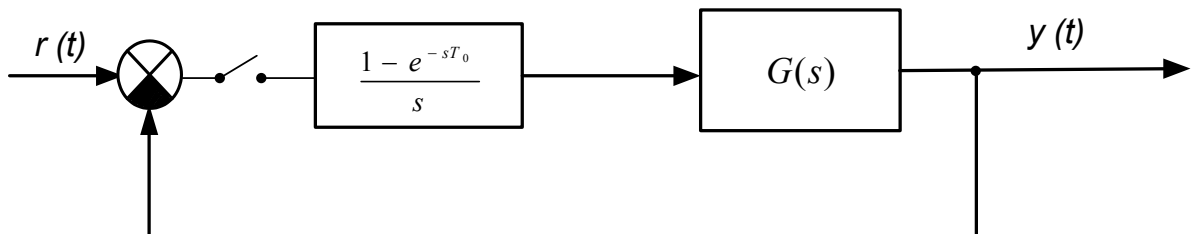
Explain the obtained results.

Figure 1 Block diagram of discrete-time control system for Task 2

Example # 3

Determine the impulse response of the closed-loop system in Task1, using MATLAB command *dimpulse.*

dimpulse(num,den) plots the impulse response of the polynomial transfer function $G(z)$ = *num(z)/den(z)* where *num* and *den* contain the polynomial coefficients in descending powers of z.

Example # 4

Draw the Bode plots of the system with pulse transfer function *G(z)* using MATLAB and determine the stability margins.

$$G\left(z\right)=\frac{0{,}12z+0{,}05}{z^2-1{,}8187z+0{,}8187}, T_0=0.2\sec.$$

Example # 5

Draw the Bode plots of the discrete-time control system, shown in Figure 2 for T_0=0.01sec.and T_0=0.005sec. Determine the stability margins
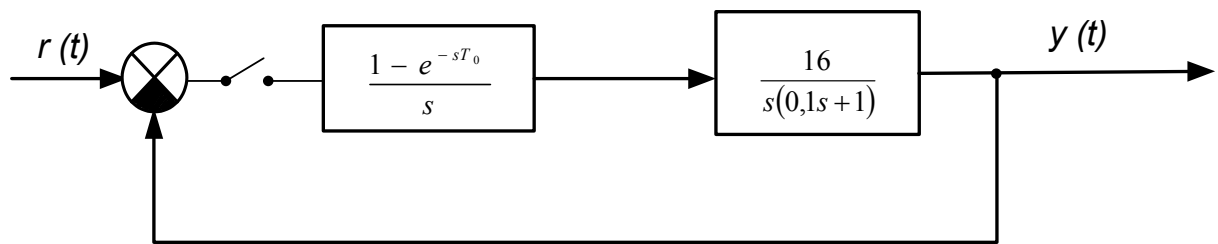

Figure 2 Block diagram of discrete-time control system for Task 5

Instruction:

Use MATLAB to obtain the pulse transfer function of the open loop discrete-time system and Bode plots.

Please, submit .m files to LMS.