Computer Controlled Systems

replacement test – 2018. 12. 20.

(The answers can be given in Hungarian)

Computational exercises (25 points)

1. Design a stabilizing state feedback gain (K), which moves the poles of the state space model (A, B, C) into (-1, -2), where (4p)

$$A = \begin{pmatrix} 1 & 2 \\ 1 & 4 \end{pmatrix}, \quad B = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \quad C = \begin{pmatrix} 0 & 1 \end{pmatrix}$$

2. Consider the following continuous-time state space model:

$$\begin{cases} \dot{x} = Ax + Bu \\ y = Cx \end{cases}, \text{ where } \quad A = \begin{pmatrix} -2 & 0 \\ 1 & -3 \end{pmatrix}, \quad B = \begin{pmatrix} 0 \\ 1 \end{pmatrix}, \quad C = \begin{pmatrix} 1 & 3 \end{pmatrix}$$

   (a) Check the system's assymptotic stability and controllability. (2p+2p)

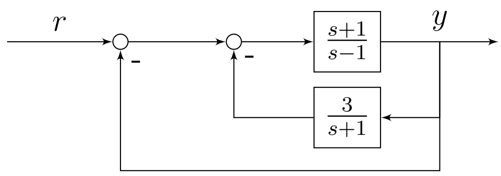
   (b) Compute the impulse response function $h(t)$ of the system. (5p)

   (c) Determine the model matrices Φ and Γ of the discretized state-space model

$$x(k+1) = \Phi x(k) + \Gamma u(k), \quad y(k) = Cx(k),$$

   if the sampling period is $h = \ln(2)$. (4p)

3. Determine the overall transfer function (from signal $r(t)$ to output $y(t)$) of the following block diagram! (4p)



4. Consider the following nonlinear system:

$$\begin{cases} \dot{x}_1 = -x_1 - 2x_2 \\ \dot{x}_2 = x_1 - 3x_2 - x_1^2 x_2. \end{cases}$$

   Show that $V(x_1, x_2) = \frac{1}{2}x_1^2 + x_2^2$ is an appropriate Lyapunov function for this system. (Check the Lyapunov conditions.) (4p)