CCS 2016 PZh

Gyakorlat - 25p

1. Compute the casual convolution of functions $f(t) = \sin(t)$ and $g(t) = t$! (4p)
2. Compute the impulse response function of the following transfer function model $H(s) = \dfrac{5s-5}{s^2-s-6}$! (3p)
3. Given the followin state space model:

$$\begin{aligned}\dot{x}_1 &= 2x_2\\ \dot{x}_2 &= 2x_3 - x_2 - x_1 + u\\ \dot{x}_3 &= \frac{1}{2}x_2 \qquad y = x_3\end{aligned}$$

   (a) Decide whether it is controllable (1p)?
   (b) Decide whether it is observable (1p)?
   (c) Tell the existence of an u input which can move the system from state $x_1 = [0\ \ -2\ \ 0]^T$ to state $x_2 = [-2\ \ 3\ \ -0.5]^T$? (1p)
   (d) Tell the existence of an u input which can move the system from state $x_3 = [0\ \ 0\ \ 0]$ to state $x_4 = [-4\ \ 0\ \ 0]^T$? (1p)

4. Let

$$x(k+1) = \begin{pmatrix} 4 & -1 \\ 2 & -2 \end{pmatrix} x(k) + \begin{pmatrix} 1 \\ -1 \end{pmatrix} u(k)$$

   Compute the shortest input sequance, which can mobe the system from $x(0) = [1\ \ 1]^T$ to $x(n) = [4\ \ -4]$! (4p)

5. Given the following state space model

$$A = \begin{pmatrix} 1 & 2 \\ p & 0 \end{pmatrix} \qquad B = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

   (a) Design a static state feedback controller, which moves the poles of the system into $[-1, -1]$! (3p)
   (b) Check your results! (1p)
   (c) For which value of p we cannot compute such a controller? (1p)

6. Given the following state space model:

$$A = \begin{pmatrix} 2 & 3 \\ -2 & 1 \end{pmatrix} \qquad B = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \qquad C = \begin{pmatrix} 1 & 1 \end{pmatrix}$$

   (a) Compute the transfer function of the system! (2p)
   (b) Is this state space realization minimal? (1p)
   (c) Write down the syste matrices in the following new coordinates: $\tilde{x}_1 = x_1 - x_2 \quad \tilde{x}_2 = x_1 + x_2$ (2p)