

Computer Controlled Systems

2nd midterm test

2018. 12. 06.

theoretical questions (25 points)

(The answers can be given in Hungarian)

1. Consider the following continuous time LTI model

$$\dot{x} = Ax + Bu \tag{1}$$

where

$$A = \begin{bmatrix} -1 & 1 \\ 1 & -2 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}.$$

Let $P = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

- (a) Show that $A^T P + P A$ is negative definite. (3p)
 - (b) Give a Lyapunov function for the system model in Eq. (1), and check that its derivative is negative whenever $x \neq 0$. (2+2p)
2. Give a short description of PID control focusing on the following details: a) block diagram of the PID controller and the complete PID control loop (containing the system to be controlled), b) the transfer function and parameters of the PID controller. (3+3p)
 3. Give the problem statement of linear quadratic control (what data are given and what is to be computed)? What equation should be solved for the controller design and what kind of feedback is obtained as a result? (4+2p)
 4. What is the purpose of a state estimator? Give the block diagram and the equations of a continuous time LTI state estimator. (2+4p)