Discrete and Continuous Dynamical Systems

Tutorial, 2018.02.21.

1. Given the following CT LTI SISO system:

$$\ddot{y}(t) + 4\dot{y}(t) + 3y(t) = 2\dot{u}(t) + u(t)$$

   (a) Give the transfer function of the system!

   (b) Give the impulse response function of the system!

2. Given the CT LTI SISO system:

$$\begin{aligned} \dot{x} &= \begin{bmatrix} -5 & 0 \\ -2 & 1 \end{bmatrix} x + \begin{bmatrix} 2 \\ 1 \end{bmatrix} u \qquad x(0) = \begin{bmatrix} 2 \\ 0 \end{bmatrix} \\ y &= \begin{bmatrix} 1 & 0 \end{bmatrix} x \end{aligned}$$

$$u(t) = 0,\ t > 0$$

   (a) Compute $y(t)$ based on the solution of the state equation!

3. Given the following CT LTI state space model:

$$\begin{aligned} \dot{x} &= \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} x + \begin{bmatrix} 3 \\ 1 \end{bmatrix} u \\ y &= \begin{bmatrix} 0 & 2 \end{bmatrix} x \end{aligned}$$

   (a) Give the state transformation T_D which diagonalizes the system!

   (b) Give the matrices A_D, B_D, and C_D of the state space model!

4. **Homework:**

   (a) Give the transfer function of your system in both parametric and numeric form!

   (b) Give the solution of the state equation for the following initial state and input!

$$\boldsymbol{x}(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad u(t) = 0,\ t > 0$$

(c) (Supplementary) Give the solution of the state equation for the following initial state and input!

$$\boldsymbol{x}(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad u(t) = \eta(t),\ t > 0$$

Deadline of submission: 2018.02.28. 8am
(Submit your homework in the moodle course in a hand written scanned pdf format! Please, write your name and neptun ID on the paper!)