Faculty of Electrical Engineering

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Course "Control Systems 2"

Exercise Sheet 5

Task 15:

The LTI state equations

$$\dot{\underline{x}} = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix} \underline{x} + \begin{bmatrix} 1 \\ 5 \\ 2 \end{bmatrix} u$$

$$y = \begin{bmatrix} 4 & 2 & 1 \end{bmatrix} \underline{x} + 3u$$

shall be transformed using the state transformation

$$\underline{\tilde{x}} = \begin{bmatrix} 1 & 0 & 1 \\ \alpha & \beta & 0 \\ 0 & 0 & 2 \end{bmatrix} \underline{x}$$

where α , β are real constant parameters.

- a) For which values of α and β is the state transformation regular?
- b) Determine the equivalent system description in $\underline{\tilde{x}}$ -coordinates for the particular parameter values $\alpha = 2$ and $\beta = 1$.

Task 16:

Given are the two LTI state equations

$$\dot{\underline{x}} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \underline{x} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 2 & 1 \end{bmatrix} \underline{x}$$

and

$$\frac{\dot{\underline{x}}}{\underline{x}} = \begin{bmatrix} 4 & 1 \\ 6 & 1 \end{bmatrix} \underline{x} + \begin{bmatrix} 2 \\ 2 \end{bmatrix} u$$

$$y = \begin{bmatrix} 2 & -0.5 \end{bmatrix} \underline{x}$$

Show that both system descriptions are equivalent.

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