Session 4

Realizations from weighting patterns, impulse responses, and Markov parameters. Minimal Realizations

Reading Assignment

Rugh Ch 10, 11 (only pp194-199, skip proof of 11.7), (26: skip all proofs, scan definitions, examples and theorems, max 30min)

Exercise 4.1 = Rugh 10.1

Exercise 4.2 = Rugh 10.2

Exercise 4.3 = Rugh 10.5

Exercise 4.4 = Rugh 10.9

Exercise 4.5 = Rugh 10.12

Exercise 4.6 = Rugh 11.4

Exercise 4.7 Perform the calculations in Rugh Example 26.21 (p497) for $\alpha = -2, 0, 1$.

Exercise 4.8 = Rugh 26.7

Exercise 4.9 = Rugh 26.8

Hand in problems

Exercise 4.10 The following system is given

$$\begin{aligned} \dot{x}_1 &= \sin(t)u(t) \\ \dot{x}_2 &= \cos(t)u(t) \\ y(t) &= \sin(t)x_1(t) + \cos(t)x_2(t) \end{aligned}$$

Calculate the weighting pattern, and show that it is stationary. Then give a time invariant realisation.

Exercise 4.11 Consider the following state-space system

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

and a transfer function matrix

$$G(s) = \begin{bmatrix} 1 & 0 \\ 1 & -2(s-1) \end{bmatrix} \begin{bmatrix} 0 & -2(s-1)^2 \\ \frac{1}{2}(s-2) & s^2+4s-4 \end{bmatrix}^{-1} \tag{2}$$

- Show that the state-space model (1) is a realization of $G(s)$ in (2);
- Is (1) a minimal realization of (2)?