

MECH468 Modern Control Engineering
MECH509 Controls

Homework 3. Due: March 8 (Monday), 11:59 pm, 2021.

1 Theoretical (hand-calculation) questions

1. Obtain controllable canonical form realization for the following transfer matrices **by hand-calculations**.

$$(a) \quad G(s) = \begin{bmatrix} \frac{1}{s^2 + s} & \frac{1}{s^2} \end{bmatrix}$$

$$(b) \quad G(s) = \begin{bmatrix} \frac{1}{s^2 + s} \\ \frac{1}{s^2} \end{bmatrix}$$

$$(c) \quad G(s) = \begin{bmatrix} \frac{1}{s+1} & \frac{1}{s(s+1)} \\ \frac{1}{s(s+1)} & \frac{1}{s^2} \end{bmatrix}$$

2. Obtain observable canonical form realization for the transfer matrices above **by hand calculations**.
3. Obtain minimal realization for the transfer matrices above **by hand calculations**.

In finding the minimal realization of (c), after obtaining a non-minimal realization **by hand-calculation**, you **can use Matlab** to compute $\text{Im}\mathcal{C}$ or $\ker\mathcal{O}$, a coordinate transformation matrix T^{-1} , and T , TAT^{-1} , TB and CT^{-1} . Do NOT use Matlab command `minreal.m`.

2 Matlab question

In HW1 and HW2, you got state-space models for the pendulum system and the inverted pendulum system, respectively. For each model, check the minimality of the state-space models.