SSY285 - LAB

Daniel Söderqvist Johannes Lundahl Marteinn Sigþórsson

November 29, 2023

Exercise 1:

- Friction and Resistance.
- Temperature Effects.
- Pump Dynamics.
- Tank Shape and Dimensions.

Exercise 2:

Volume balance equation:

$$A\frac{dh_i}{dt} = q_{in,i} - q_{out,i} \quad \text{for } i = 1, 2 \tag{1}$$

With given equation (3) and (5) combined with (1) we then get:

$$\frac{dh_1}{dt} = \frac{1}{A}(K_q u_1 - a\sqrt{2gh_1} - K_{12}(h_1 - h_2))$$
$$h_1 = K_h V_1$$
$$\frac{dh_2}{dt} = \frac{1}{A}(K_q u_2 - a\sqrt{2gh_2} + K_{12}(h_1 - h_2))$$
$$h_2 = K_h V_2$$

Exercise 3:

See matlab exercise 3.

Exercise 4:

Using given equations and the ordinary state space model we get the following answers by substitution and differentiating:

$$A_z = TAT^{-1}$$

$$B_z = TB$$

$$C_z = CT^{-1}$$

See matlab exercise 4.

Exercise 5:

See matlab exercise 5.

Exercise 6:

See matlab and simulink exercise 6.

Exercise 7:

See matlab and simulink exercise 7.

Exercise 8 and 9:

See matlab and simulink exercise 8 and 9.

Exercise 10:

See matlab and simulink exercise 10.

Exercise 11:

- `c2d`: Converts continuous-time dynamic system models to discrete-time models.
- `dlqr`: Computes the optimal state feedback gain for a discrete-time linear quadratic regulator (LQR) problem.
- `lqrd`: Designs a discrete-time linear quadratic regulator (LQR) controller with integral action.
- `dlqe`: Computes the optimal state estimator gain for a discrete-time linear quadratic estimation problem.
- `lqed`: Designs a discrete-time linear quadratic estimator (LQE) with integral action.

Where, a regulator is concerned with controlling the system, while an estimator is focused on estimating the internal states of the system. These components often work together in a control system, where the regulator uses state estimates from the estimator to generate control inputs for the system.