Systems and Control - AE 315, 231

Week 4: Assignment No. 4 (Due 27 September 11:59 p.m.)

King Fahd University for Petroleum and Minerals - Aerospace Dept.

September 20, 2023

Assignment Instructions

1. Attempt all the presented questions for partial grades.
2. Deliverables:
   (a) The **MATLAB script** (.m) file.
   (b) A **report** showing your work (.pdf). Please stick to the formal report format (cover page, table of contents, introduction, ...)
   (c) Name your files according to this format: `AE_315__Your_Name__HW_#.(pdf/m)`

1 Fluid system

Suppose you have the following fludic system that has the following parameters, $A = 5$, $R_f = 0.5$, with $h_0 = 0$ m and $t_{\text{end}} = 20$ s.

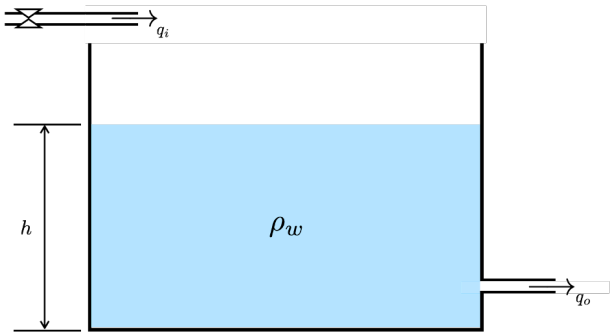

Figure 1: Fluid system

1. (1 points) Derive the equation of motion governing the system shown in figure 1.
2. (1 points) Use Laplace transform to get the transfer function of the system.
3. (2 points) Simulate the unit step response of the system using MATLAB ode45 routine, and using Laplace transform.
4. (2 points) Use SIMULINK to also simulate the unit step response of the system in both time and Laplace domain using the transfer function.

5. (4 points) Compare the results obtained in Steps 2 and 3 visually using an appropriate plot that includes legends, x-label, y-label, etc. Then, compute the Root Mean Squared Error (RMSE) between each pair of datasets to quantitatively compare them. Specifically, calculate the RMSE between e.g.:

   - The data obtained from ode45 and the transfer function
   - The data from ode45 and SIMULINK
   - The data from the transfer function and SIMULINK
   - ... and so on.

   The RMSE values should be close to zero, indicating little difference between each pair of results.

6. **(+1 points)** Find a way in MATLAB to automatically calculate:

   (a) Rise time
   (b) Transient time
   (c) Settling time
   (d) Overshoot
   (e) Peak time

   of the step response of the system.