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M E M O R A N D U M

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Date: Nov. 3, 2020

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Course: ME 422 – 07

Team: Group 10

Subject: Fluid Level Control (Two Tanks) Lab Part 1

Objective / Procedure

The objective of the Fluid Level Control Lab is to study regulation control and record system responses for a system of two identical water tanks connected to each other and a reservoir through shutoff valves. The bottom tank has an additional valve that acts as a disturbance. Using regulation control, the goal is to keep the water height in the top tank at its steady state value with external inputs, or disturbances, attempting to change this value. For part 1, the system will be open loop and will be revisited in part 2 as closed-loop.

For the procedure, there is a pre-built Simulink model that is used to run the control system. Using the model, values for actuation voltage, percent valve opening, and inlet valve flowrate are obtained. The slopes of the curves for percent valve opening vs. voltage and inlet valve flowrate vs. percent valve opening represent experimentally determined gain values. Next, the transducer voltages are recorded at various tank heights for top and bottom tanks.

Results and Discussion

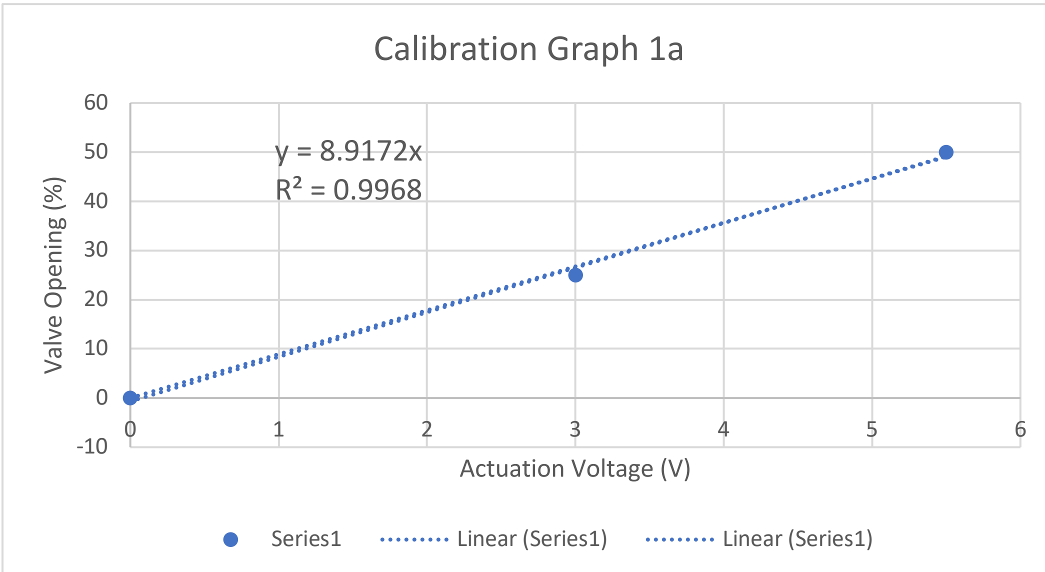

Figure 1: The calibration constant was determined for step 1a by plotting valve opening percentage vs. actuation voltage.

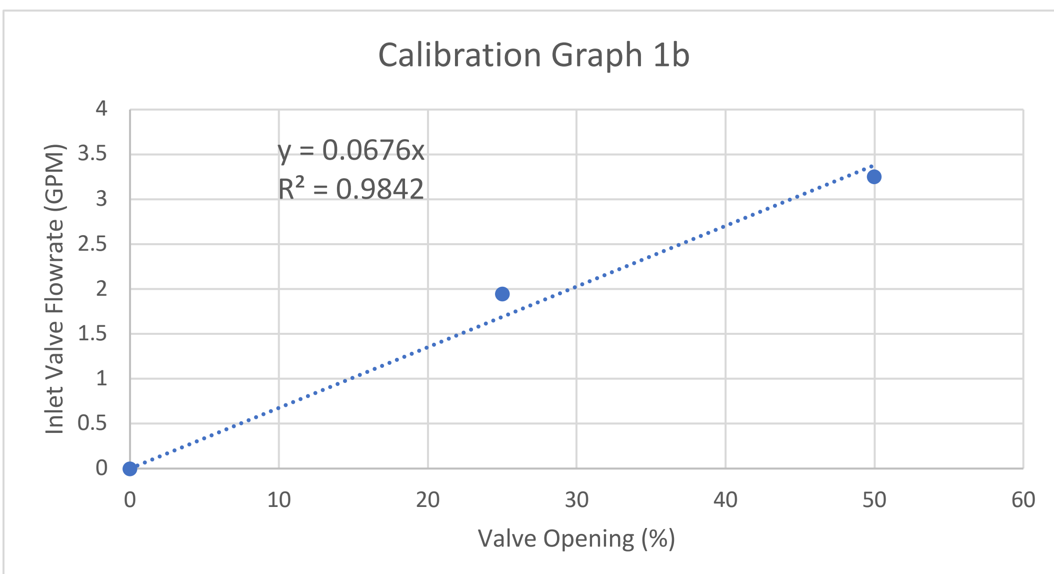

Figure 2: The calibration constant was determined for step 1b by plotting inlet valve flowrate vs. valve opening percentage.

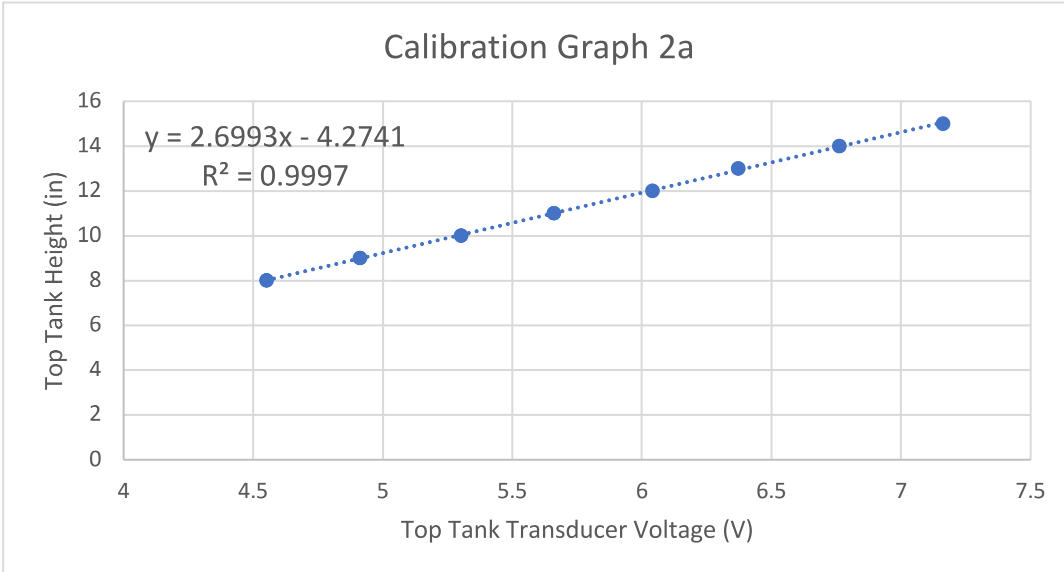

Figure 3: The calibration constant was determined for step 2a by plotting top tank height vs. top tank transducer voltage.

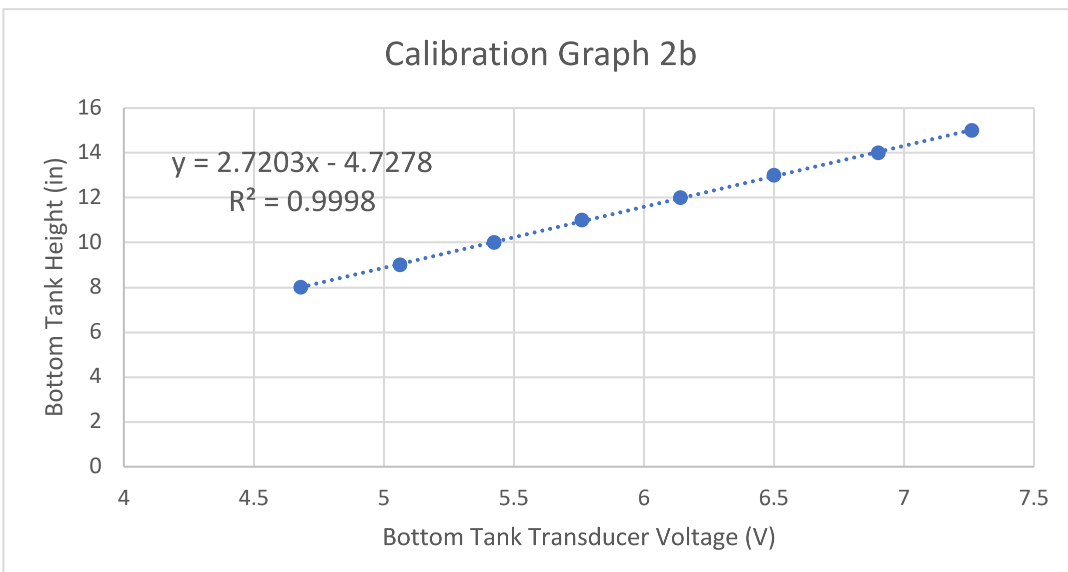

Figure 4: The calibration constant was determined for step 2b by plotting bottom tank height vs. transducer voltage.

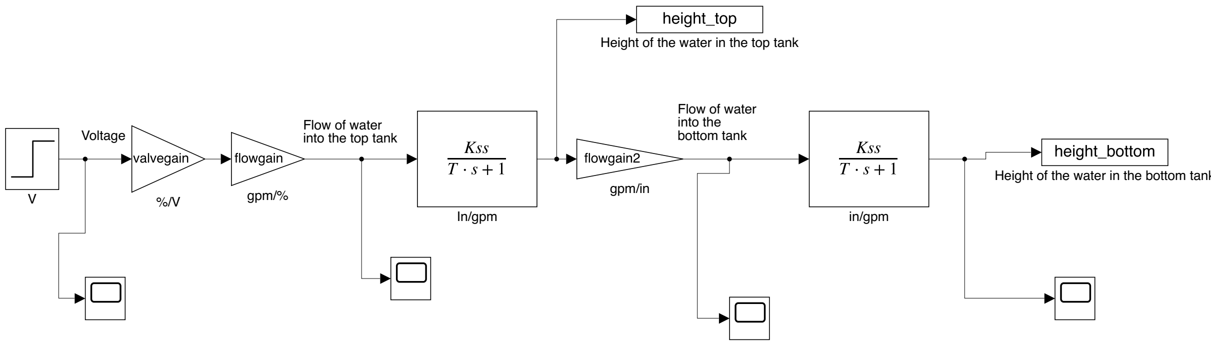

Figure 5: Simulink block diagram for the two tanks system.

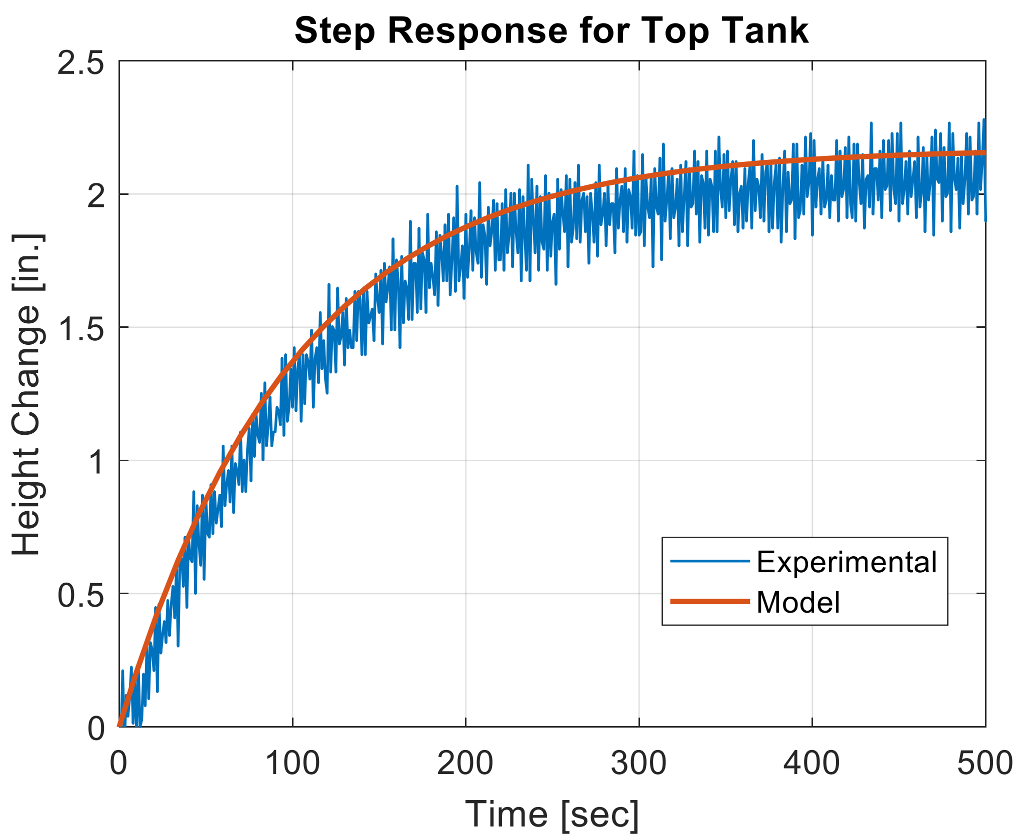

Figure 6: Top tank simulation and experimental step responses

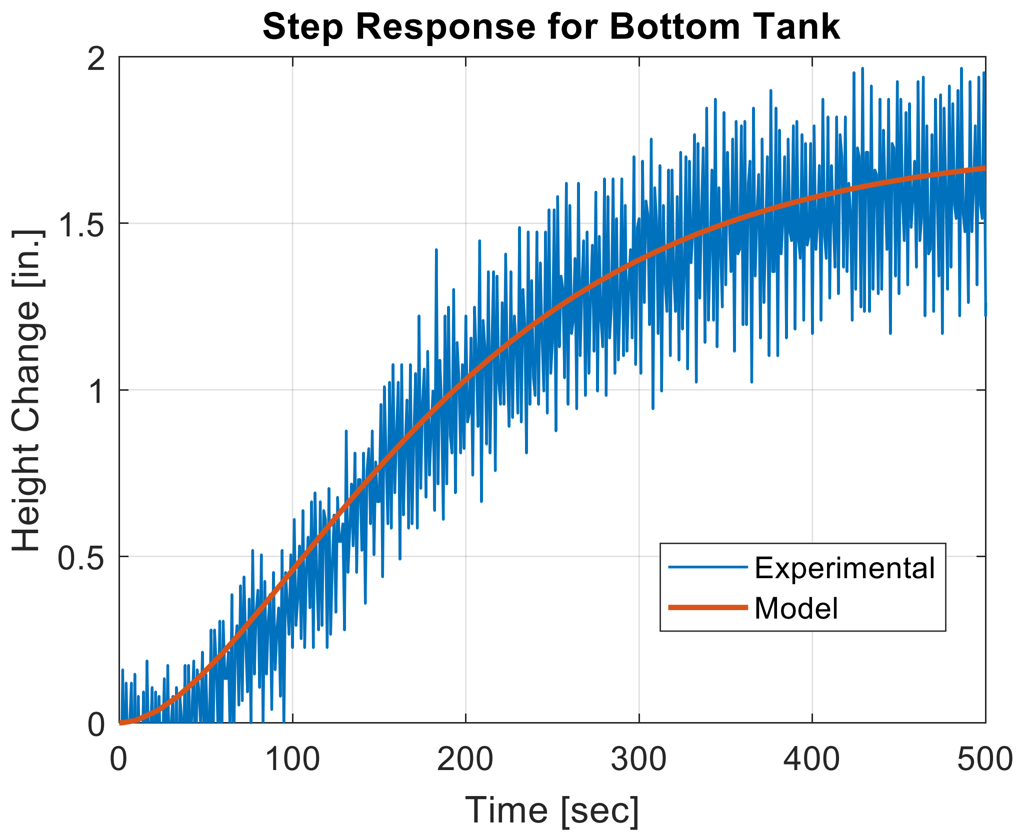

Figure 7: Bottom tank simulation and experimental step responses

Table 1: Parametric values for Simulink block diagram

Parameter	Value
Valve Gain [%/V]	8.9172
Flow Rate Gain [gpm/%]	0.0676
Steady State Gain, Kss	1
Flow Gain [gpm/in]	0.8
Time Constant [sec]	100

Conclusion

In the first week of the Fluid Level Control Lab, gain values for the parameters and time constant were experimentally determined. Using the experimental values, an open-loop Simulink model was created, and step responses for the top and bottom tanks were compared to their experimental responses. These plots are in agreeance after tuning. This lab demonstrates regulation control, bringing the system to and keeping the system at steady state.