UPPSALA
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Model Based Design of Embedded Systems
1DT059
Report A1

Simulink Matlab

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September 10, 2020

Solution - 1

1a

The equations for the system of tanks can be described as follows[1]:

$$\frac{dh_1}{dt} = \frac{1}{A}(Inflow_1 - 0.1h_1) \tag{1}$$

$$\frac{dh_2}{dt} = (0.1h_1 - 0.1h_2) \tag{2}$$

1b

The simulink models have been attached in the folder.

1c

On solving Equation 1 for h1 we get the following:

$$h_1 = \frac{dh_2}{dt} * (0.1) + 1 \tag{3}$$

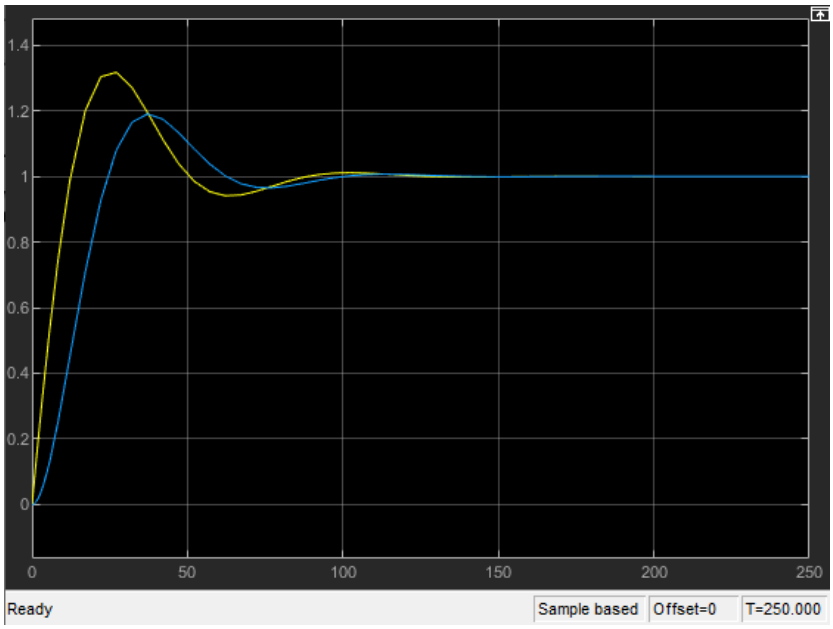
Substitute for h1 from equation 3 in 1 and this results in:

$$Inflow_1 = \frac{dh_1}{dt} + \frac{dh_2}{dt} * (0.1) + 0.1 \tag{4}$$

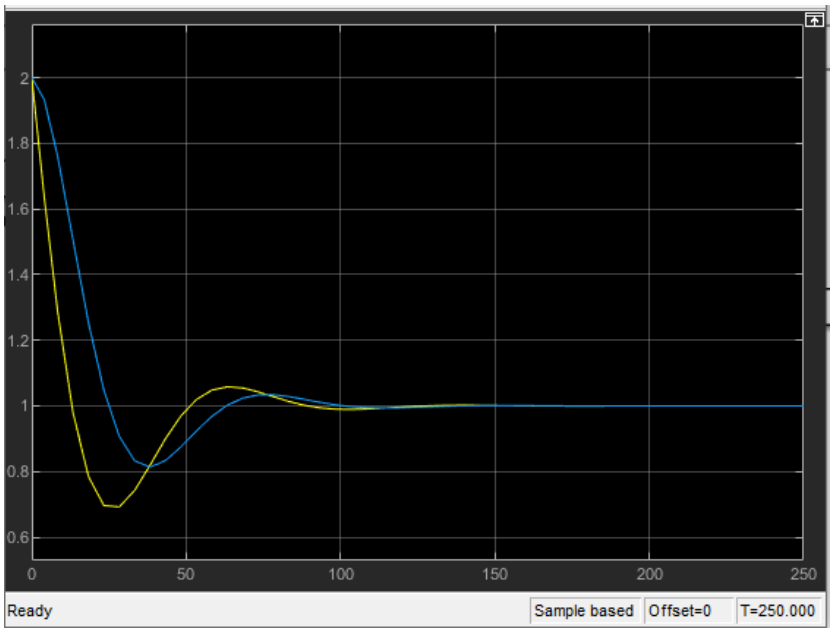
Using Equation 4 we can design the controller to control the flow of water from the tanks to the desired levels.

1d

The Graph for both tanks empty:



The graph for both tanks full:



Solution - 2

2a

$$\theta'' = -\frac{g}{l}\sin(\theta) - \frac{b}{M}\theta' \tag{5}$$

To Linearize the above equation replace $\sin\theta$ with θ and $\cos\theta$ with 1 and we get:

$$\theta'' = -\frac{g}{l}\theta - \frac{b}{M}\theta' \tag{6}$$

Using equations 5 and 6 models are made and the simulations are added. Constants M,l and b are added as parameters to the blocks.

2b

Using the two models with initial conditions $\theta = \pi/4$ and $\theta' = 0$. Calculating the number of completed periods by using a simple triggered counter for the both the waves. The percentage of difference is then calculated. On simulating the model for 50sec time period, the frequency differs by 2%

References

[1] Link:
https://se.mathworks.com/help/slcontrol/gs/watertank-simulink-model.html