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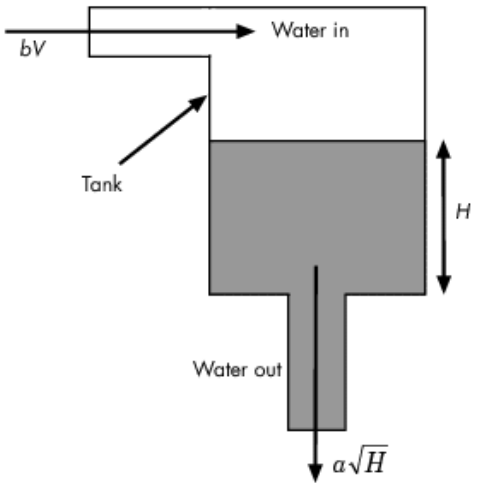
SYS 5160

Assignment 2

Fuzzy Logic Level Control of a Cylindrical Water Tank

Consider a cylindrical water tank. Water enters the tank from the top at a rate proportional to the voltage, V, applied to the pump. The water leaves through an opening in the tank base at a rate that is proportional to the square root of the water height, H, in the tank. The presence of the square root in the water flow rate results in a nonlinear plant.



The differential equation for the tank is given by

$$\frac{dH}{dt} = \frac{bV - a\sqrt{H}}{\pi R^2}$$

where *R* is the radius of the tank, H is actual water height in the tank, *V* is the voltage applied to the pump, *a* (in m^2 per minute) is a constant related to the flow rate out of the tank and *b* (in m^3 *per minute per volt*) is a constant related to the flow rate into the tank. The goal is to design a fuzzy logic controller for the pump so that the water level is always at the desired level.

a) Simulate your design using the following data:

R = 5 m, V_{max} = 48 volts, a = 0.1, b = 0.01, H(0) = 0 m, desired H = 4 m

b) Simulate your design using the following data:

R = 5 m, V_{max} = 48 volts , b = 0.01, H(0) = 1 m , desired H = 5 m

$$a(t) = \begin{cases} 0.1 & t \le 20\text{min} \\ 0.2 & t > 20\text{min} \end{cases}$$