Lab 8: Using Fuzzy Logic

1 Objectives

The main objective for this lab is to explore how Fuzzy Logic Systems work and experiment with the Fuzzy characteristics. We will use a standard example which controls the water level in a tank using a fuzzy valve controller.

In this lab you will have a break from Python and will use Matlab

1. Run Matlab
2. Load the Fuzzy Logic Water Talk Controller
3. Run simulations of the Fuzzy Logic Water Tank Controller
4. Experiment with the fuzzy logic parameters

At the end of this laboratory session you should have a better understanding of the nature of fuzzy logic systems and be able to see how they operate.

2 Getting Started

We will be using Matleb, not Python, in this lab, so run Matlab from one of the lab computers. In the Matlab command line please load up the fuzzy logic controller:

fuzzy('tank')

This will load up the fuzzy logic controller as shown in Figure 1.

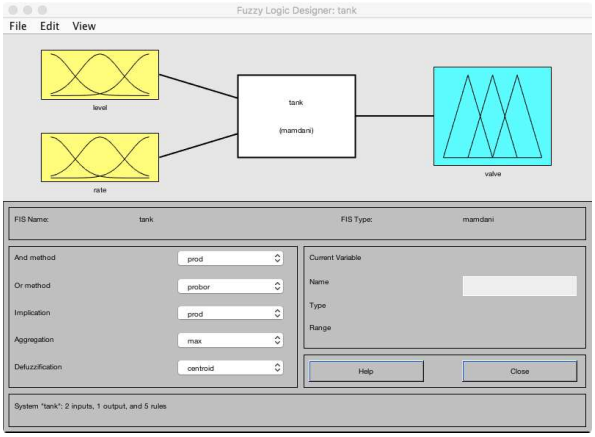

Figure 1: Fuzzy Controller for Water Tank Example

leave this for now and next load up the simulink model of the water tank system using the following command:

sltank

This will then load up the simulink model as shown in Figure **??**.

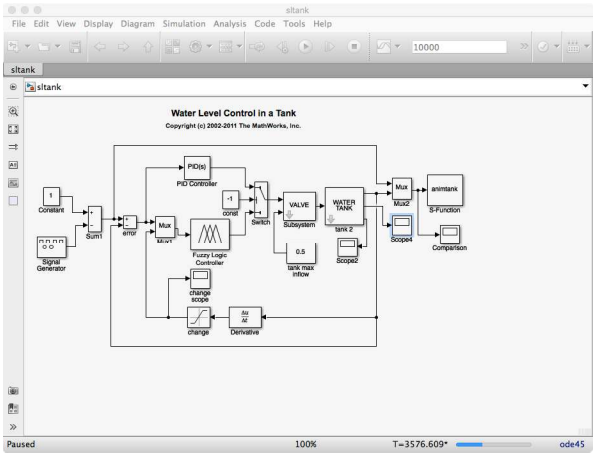

Figure 2: Water Tank Control System Example

You can see the fuzzy logic controller implemented as a block in the simulink design and the simulink model can be simulated to observe the behaviour of the controller using the fuzzy logic controller in Figure **??**.

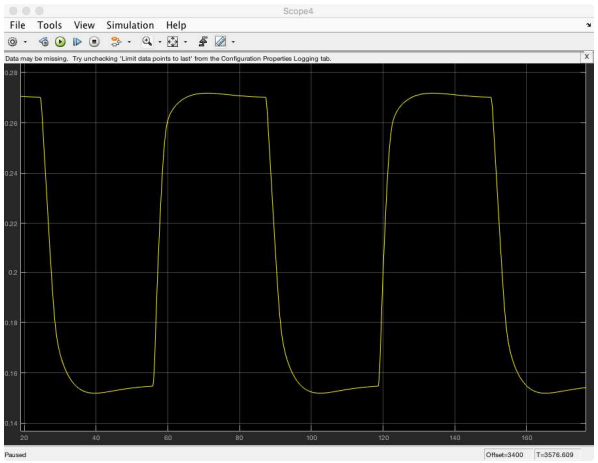

Figure 3: Water Tank Control System Example Water Level

The membership functions can also be plotted by double clicking on the fuzzy logic interface and they will popup in a new window.

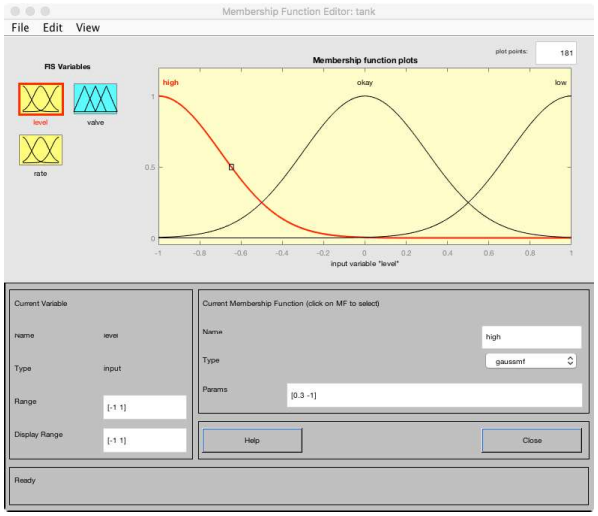

Figure 4: Fuzzy logic Membership functions

3 Comparison with a standard PID controller

The Simulink model allows the use of a PID controller, by changing the constant selector input to the switch model. If the switch is set to -1, then the Fuzzy controller is used, however +1 means the PID controller is used.

Try experimenting with the PID parameters and see the effect this has on the control.

4 Experimenting with the fuzzy logic controller

The fuzzy logic controller can be modified by clicking on the membership function settings and the values of each set can be modified as can the function (the default is Gaussian, but can be changed to trapezoidal or triangular for example).

Is there a difference between Gaussian, Triangular and Trapezoidal functions?

What happens if you change the values of the membership functions?