

CO542 - Neural Networks and Fuzzy Systems
Lab 1 - Fuzzy Logic
E/15/077

Scenario

Suppose you need to control the speed of a motor by changing the input voltage. When a set point is defined, if for some reason, the motor runs faster, we need to slow it down by reducing the input voltage. If the motor slows below that set point, the input voltage must be increased so that the motor speed reaches the set point.

Use the following as input and output action words:

Input:	Output:
Too slow	Less voltage (Slow down)
Just right	No change
Too fast	More voltage (Speed up)

Lab Tasks

1. Define the rule-base for the scenario (Refer Figure 4)

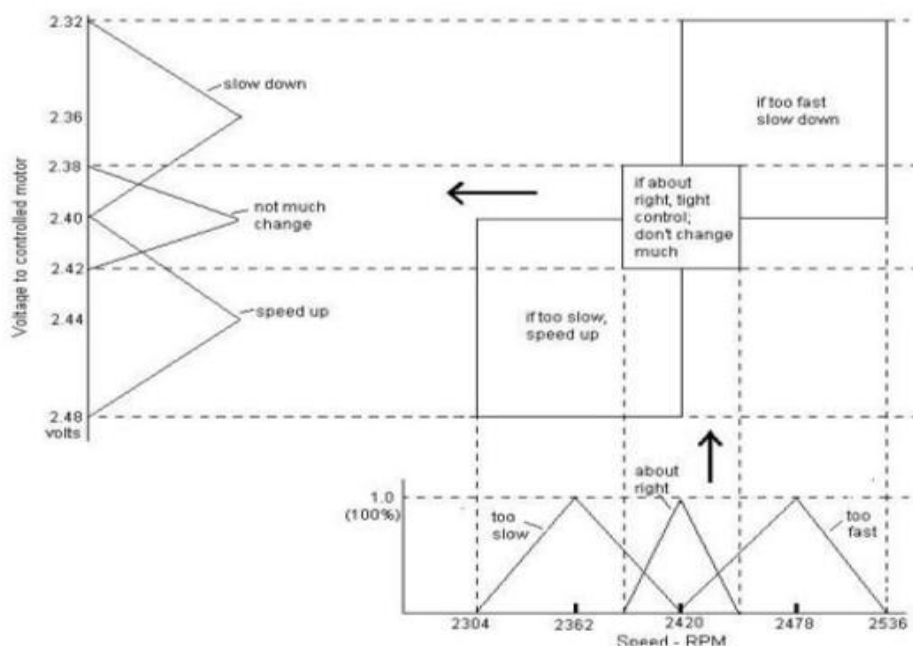


Figure 4. Membership Functions (I/P: Speed O/P: Voltage)

- Rule 1: If speed too slow then speed up**
Speed (Too slow) => Voltage (More voltage)
- Rule 2: If speed about right then don't change much**
Speed (Just right) => Voltage (No change)
- Rule 3: If speed too fast then slow down**
Speed (Too fast) => Voltage (Less voltage)

2. Suppose, the speed increases from the set point of 2420 to 2437.4rpm. This is depicted as the membership function shown in Figure 5. Calculate required voltage to maintain a rpm at set speed.

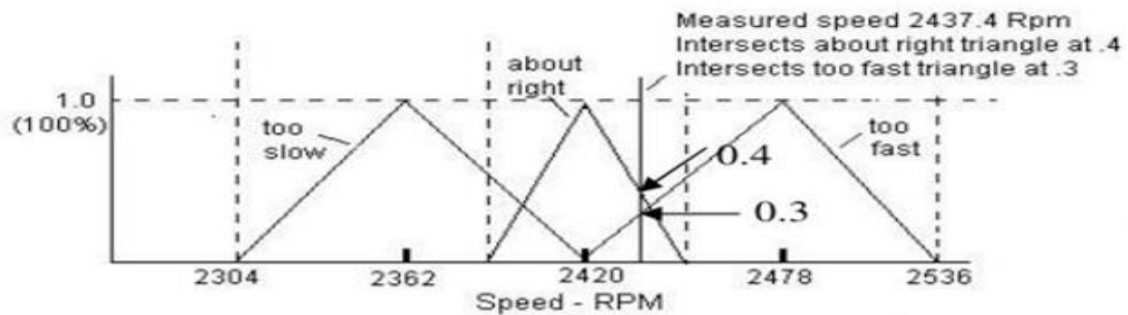
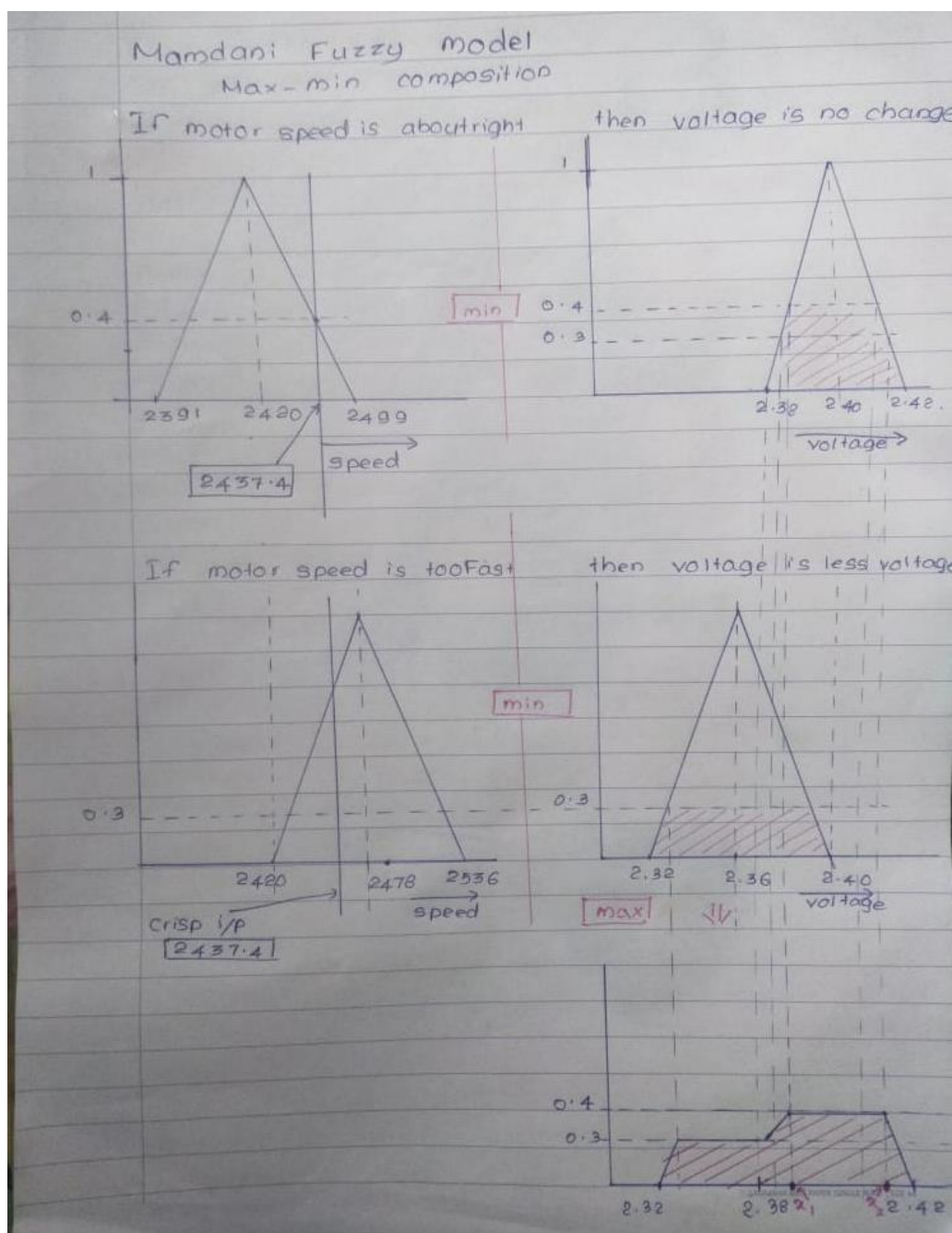


Figure 5: Speed above set point (set point=2420rpm)



Calculation:

TooFast -> 0.3

TooRight -> 0.4

Let's find x1 and x2

$$\frac{1}{2.40-2.38} = \frac{0.4}{x1-2.38}$$

$$x1 = 2.388 \text{ V}$$

$$\frac{1}{2.40-2.42} = \frac{0.4}{x2-2.42}$$

$$x2 = 2.412 \text{ V}$$

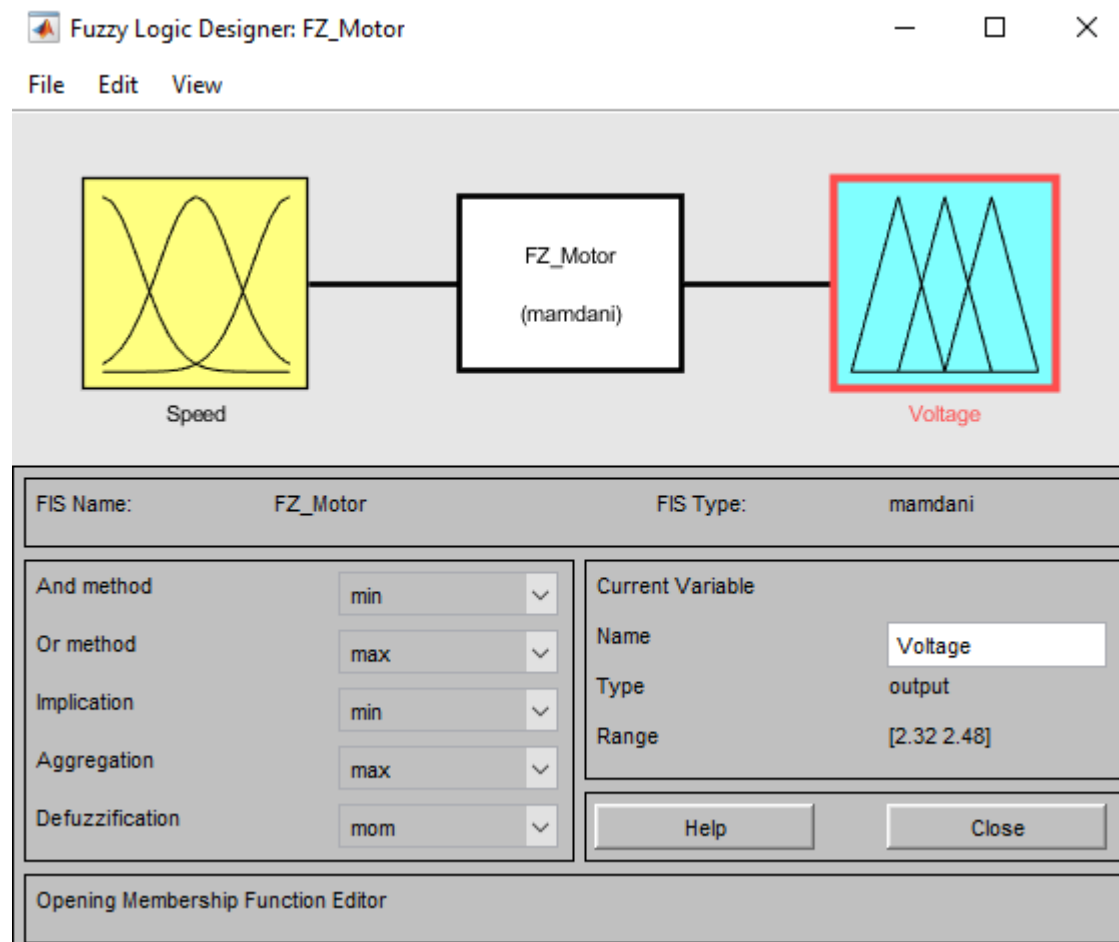
Using mean of Maxima Defuzzification method :

$$X^* = \frac{(x1+x2)}{2} = 2.40 \text{ V}$$

Therefore the required voltage to maintain rpm at set speed is only 2.40V

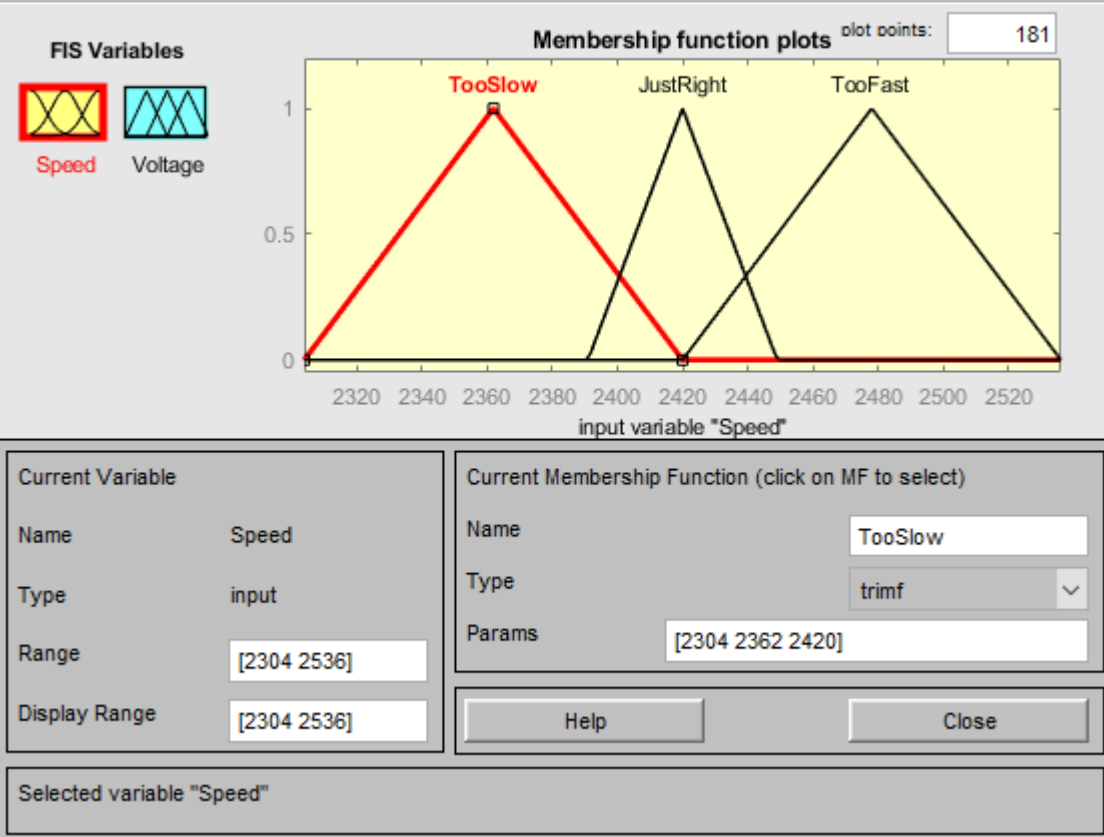
3. Solve the same using Fuzzy Logic toolbox in Matlab.

- Draw the appropriate membership functions using "Membership Function Editor"



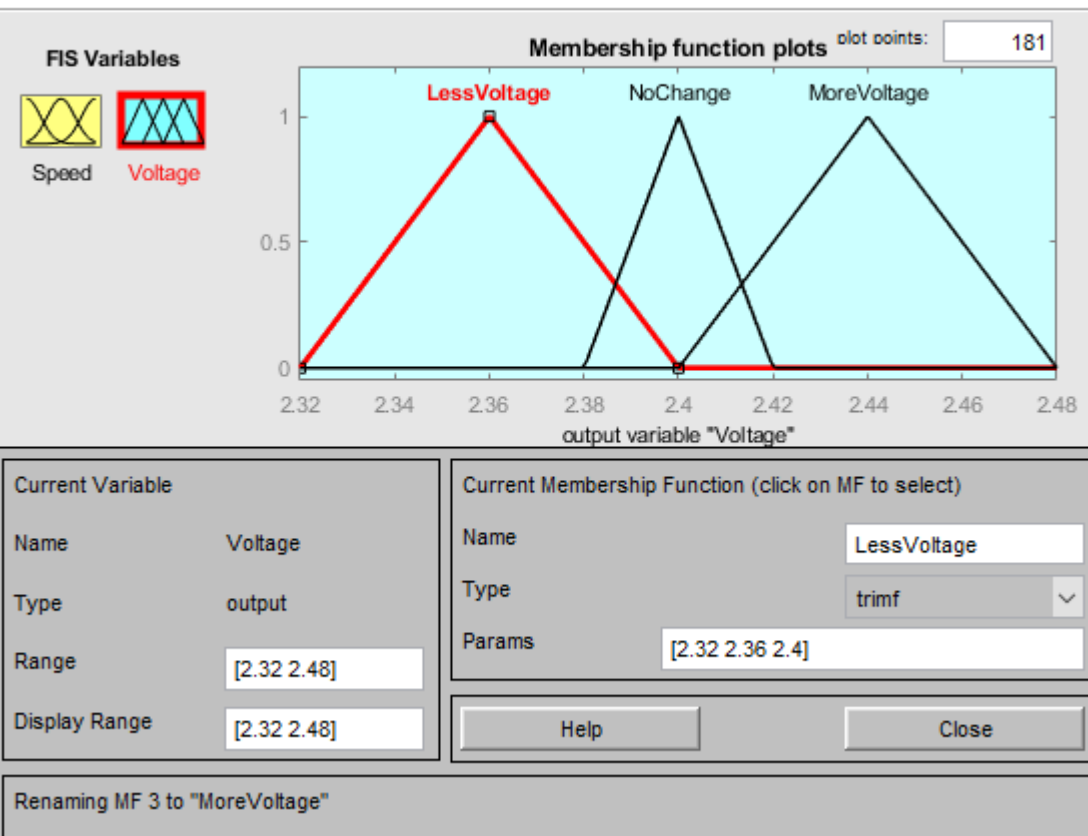
Membership Function Editor: FZ_Motor

File Edit View

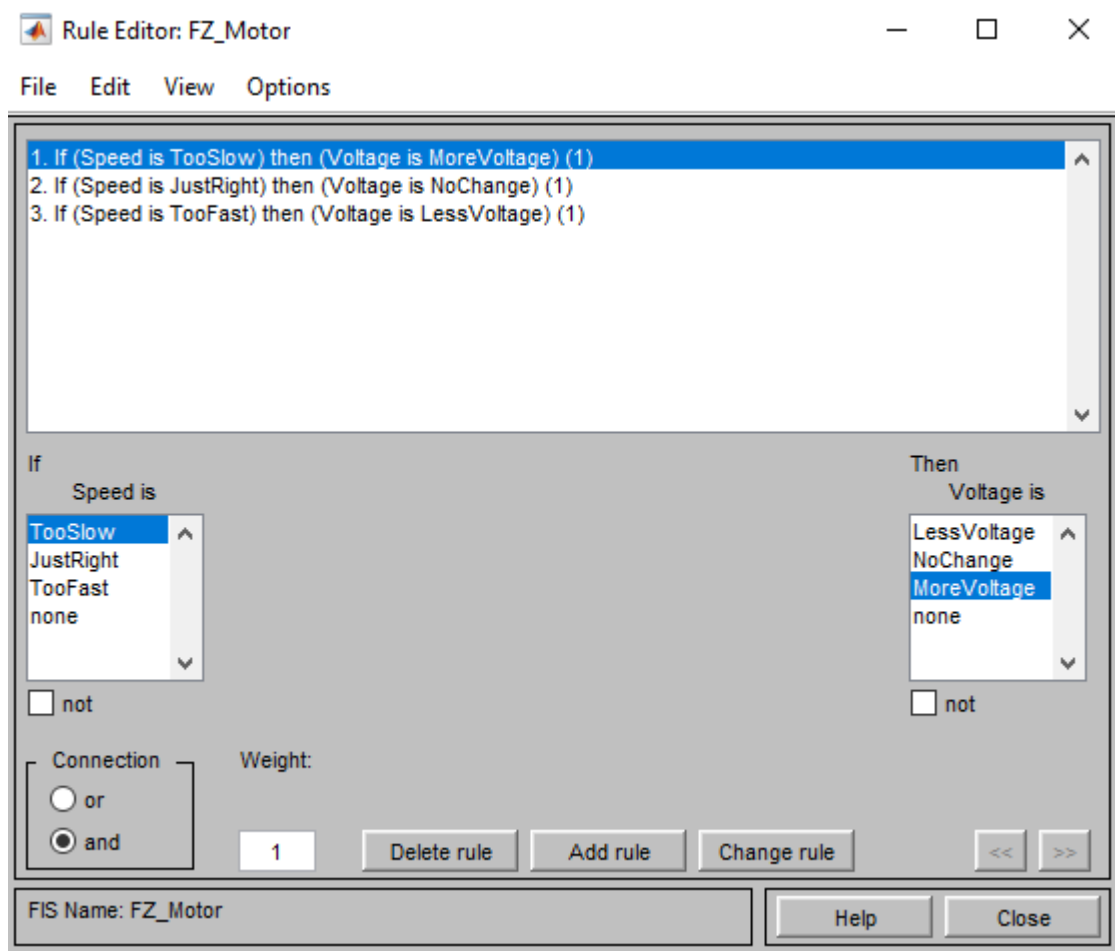


Membership Function Editor: FZ_Motor

File Edit View



- Use “Rule Editor” to create rules



- Save the file and calculate the appropriate input voltage

```
>> fis = readfis('FZ_Motor.fis')

fis =

    struct with fields:

        name: 'FZ_Motor'
        type: 'mamdani'
        andMethod: 'min'
        orMethod: 'max'
        defuzzMethod: 'mom'
        impMethod: 'min'
        aggMethod: 'max'
        input: [1x1 struct]
        output: [1x1 struct]
        rule: [1x3 struct]

>> evalfis(2437.4,fis)

ans =

    2.4000
```