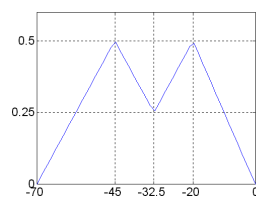


Intro to Fuzzy Inference Systems 2

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- Finally, the steering angle is determined by defuzzifying the output MF.
- In this course, centroidal defuzzification is preferred.

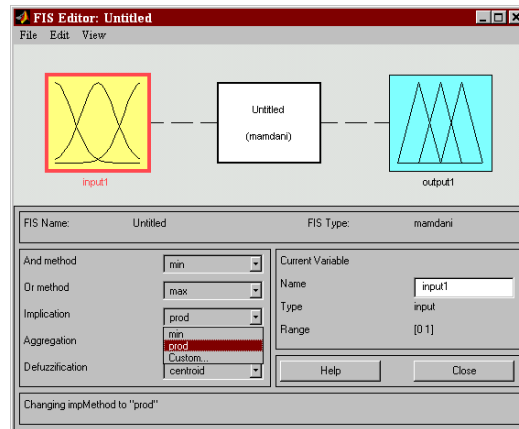


Defuzzify

$$\beta = \frac{\int \mu x dx}{\int \mu dx}$$

$\beta = -34.1697$

- Type 'fuzzy' at the matlab prompt to bring up the GUI fuzzy designer.
- First, select product implication, the other default methods are fine.



- Now select Edit_Add Variable..._Input to make it a two input-one output system.
- Click on each input membership function, and change the names appropriately.
- Now double-click the first input to bring up the membership function editor:
- A good first step is to define the Range and display Range.

- Now add 2 more MFs since we want 5 total: Use Edit_Add MFs...Add triangular MFs for now using 'trimf'.
- Note that you can click and drag the corners of an MF to change its position. It is just as easy to explicitly type the parameters in the window, and thus get precisely what you want:
- It is good practice to assign the mfs in numerical order such that mf1='LN', mf2='N', ..., mf5='LP'. This will make it easier to export the controller to other languages (FORTRAN, etc.)

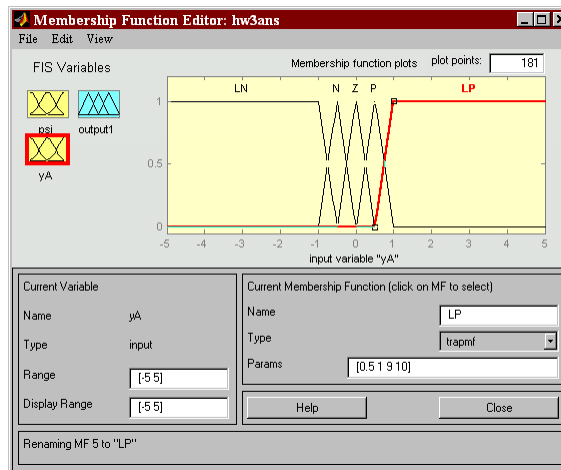
- Type the linguistic names 'LN', 'N', etc. in the window.
- When you are finished with ψ , you should have something like this:

The screenshot shows the 'Membership Function Editor' window. The plot area displays five triangular membership functions labeled LN, N, Z, P, and LP. The x-axis is labeled 'input variable "psi"' and ranges from -40 to 40. The y-axis represents the membership degree from 0 to 1. The 'Current Membership Function' section shows the following details:

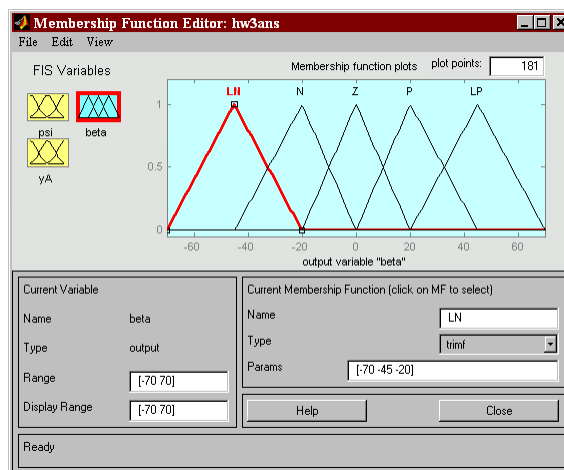
Current Variable		Current Membership Function (click on MF to select)	
Name	psi	Name	LP
Type	input	Type	trimf
Range	[45 45]	Params	[15 30 45 50]
Display Range	[45 45]	<input type="button" value="Help"/> <input type="button" value="Close"/>	

Changing parameter for MF 5 to [15 30 45 50]

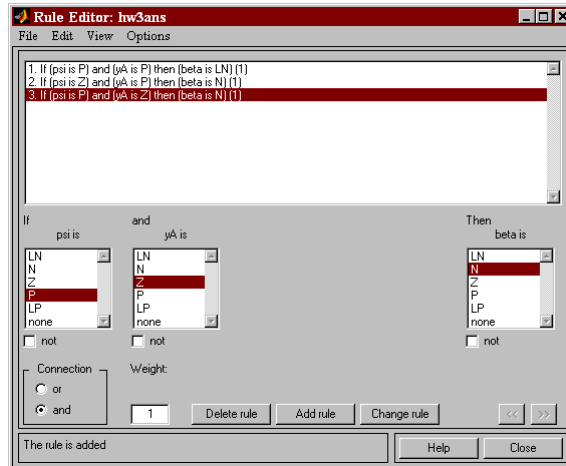
- Follow the same procedure to partition the y_A input space.



- Double-click the output mf block and partition the output space:



- Double-click the middle block to open the Rules Editor
- Here are the first 3 rules



- Note the default selections. You must intentionally select 'OR' or 'NOT'
- Check out the Options menu. You can work in your choice of 3 languages, and your choice of 3 modes from verbose to indexed.
- Finish the rule base, and try running your controller. Tune by trial and error.

- Advantage--We have designed a decent controller by formalizing human knowledge. That is, we needed little or no knowledge of feedback control theory to build a successful controller.
- The fuzzy controller provides a smooth control input as the inputs move from one mf to another.

