Terna Engineering College
Computer Engineering Department

Program: Sem VII

Course: Artificial Intelligence & Soft Computing (AI&SC)

Experiment No. 07

PART B

(PART B: TO BE COMPLETED BY STUDENTS)

(Students must submit the soft copy as per the following segments within two hours of the practical. The soft copy must be uploaded on the Blackboard or emailed to the concerned lab in charge faculties at the end of the practical in case there is no Blackboard access available)

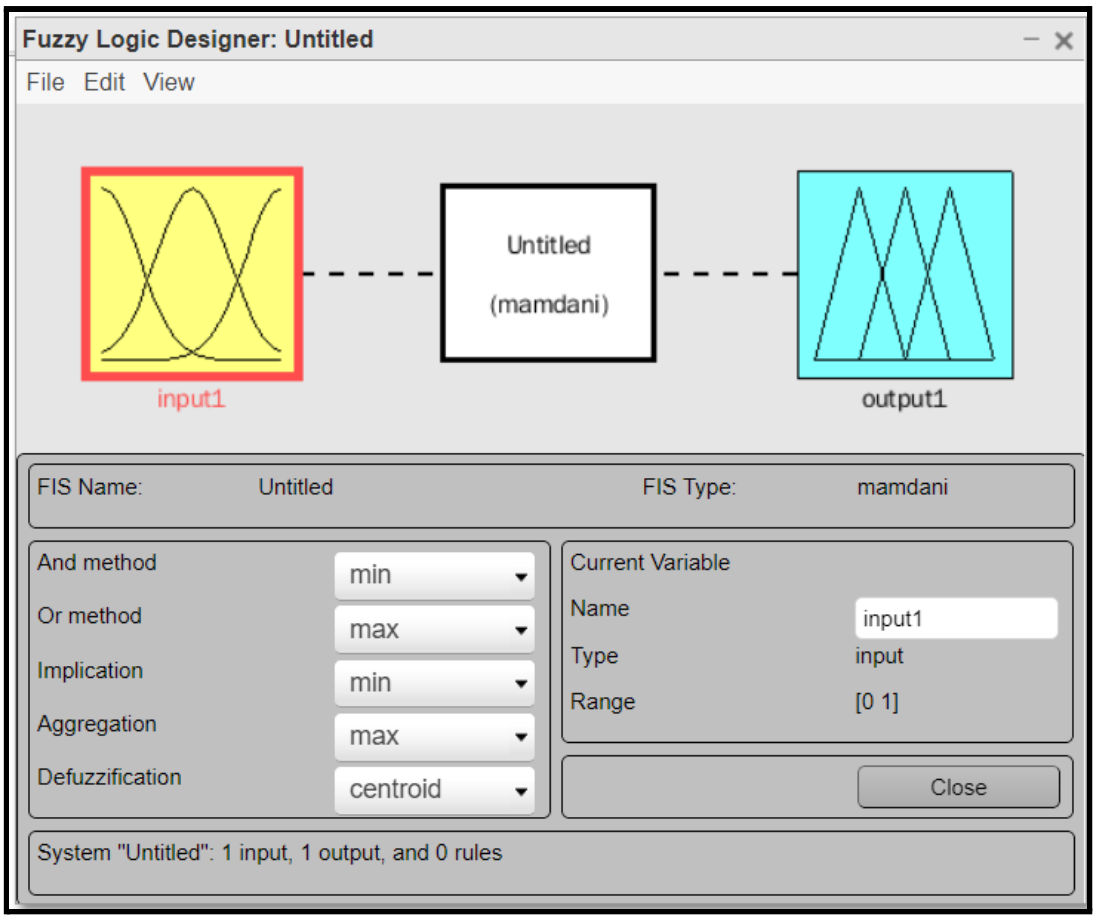
Roll No. 50	Name: AMEY THAKUR
Class: BE-COMPS-50	Batch: B3
Date of Experiment: 02-10-2021	Date of Submission: 02-10-2021
Grade :	

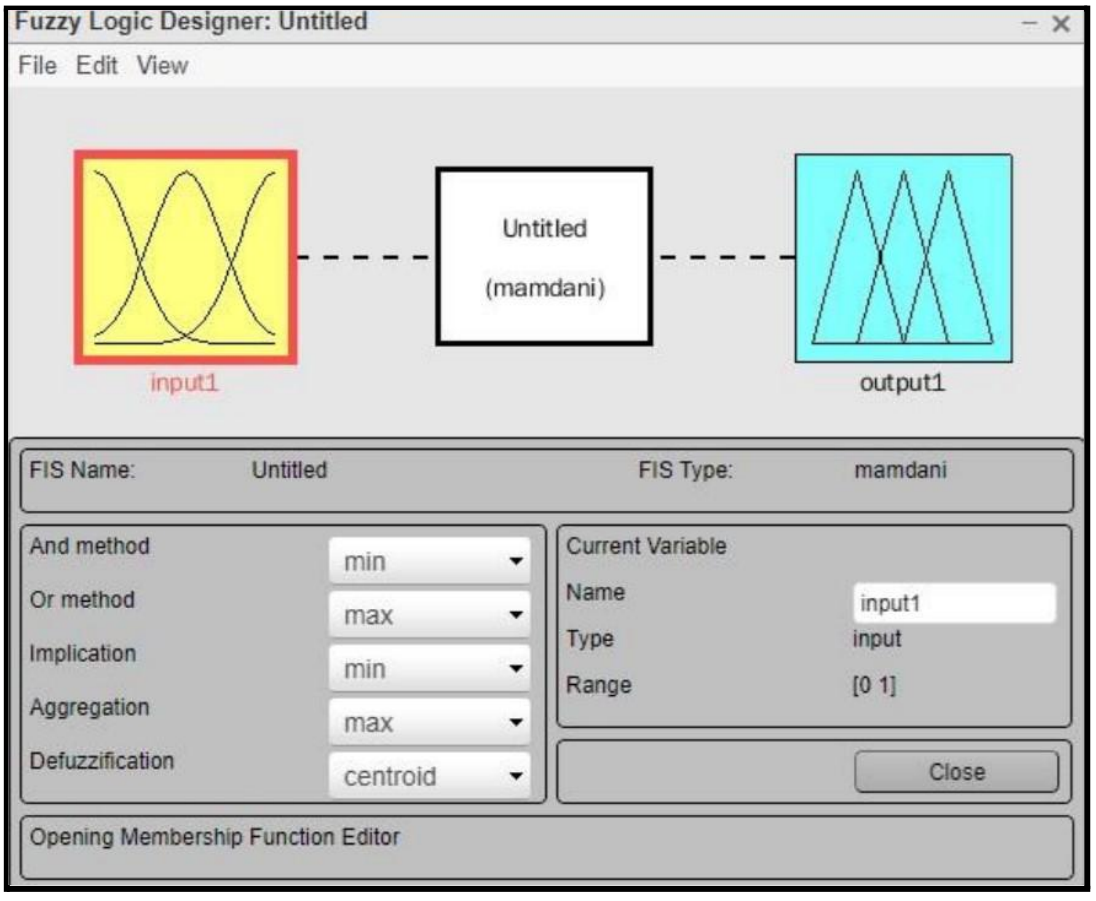
Aim: To Implement Fuzzy-Controller.

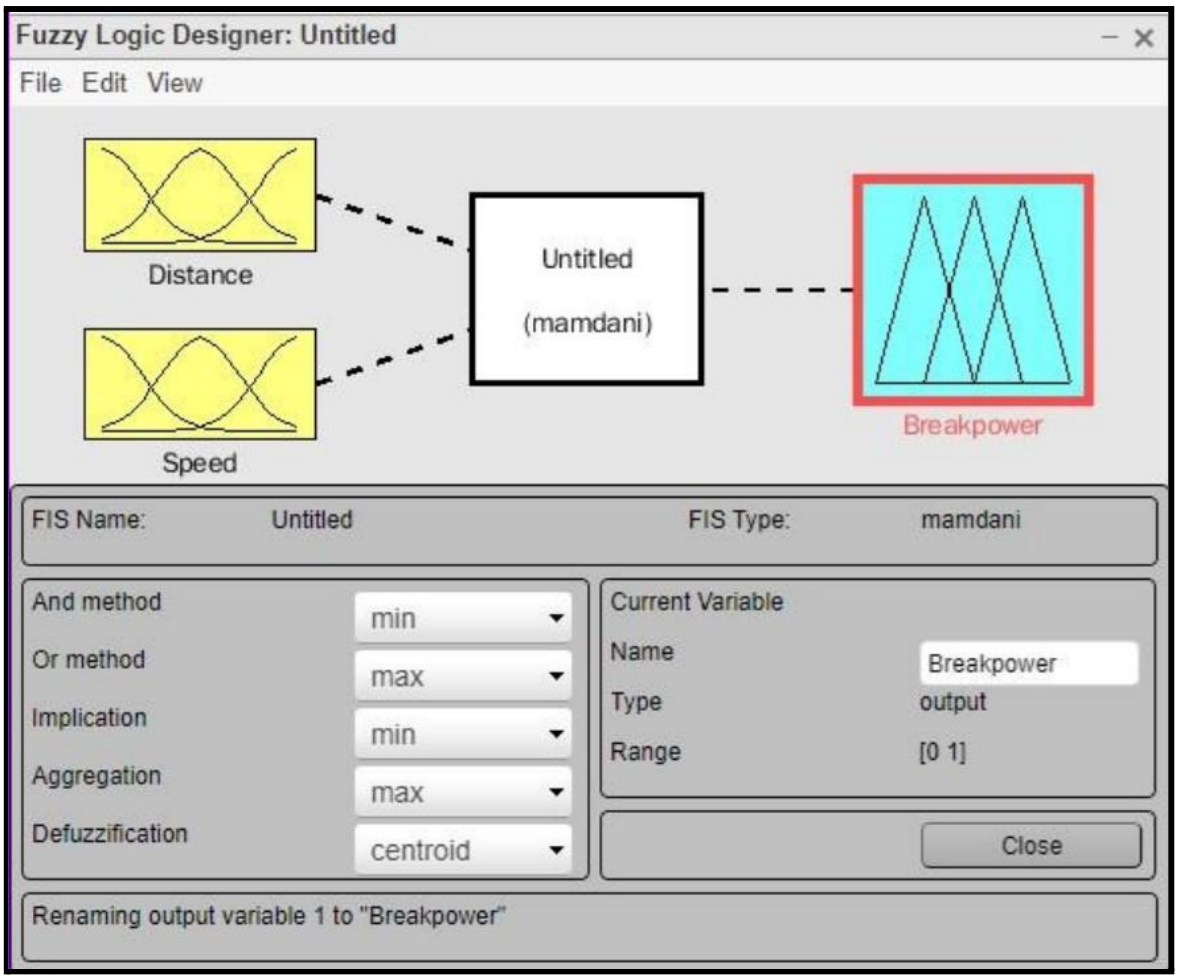
B.1 Software Code written by a student:

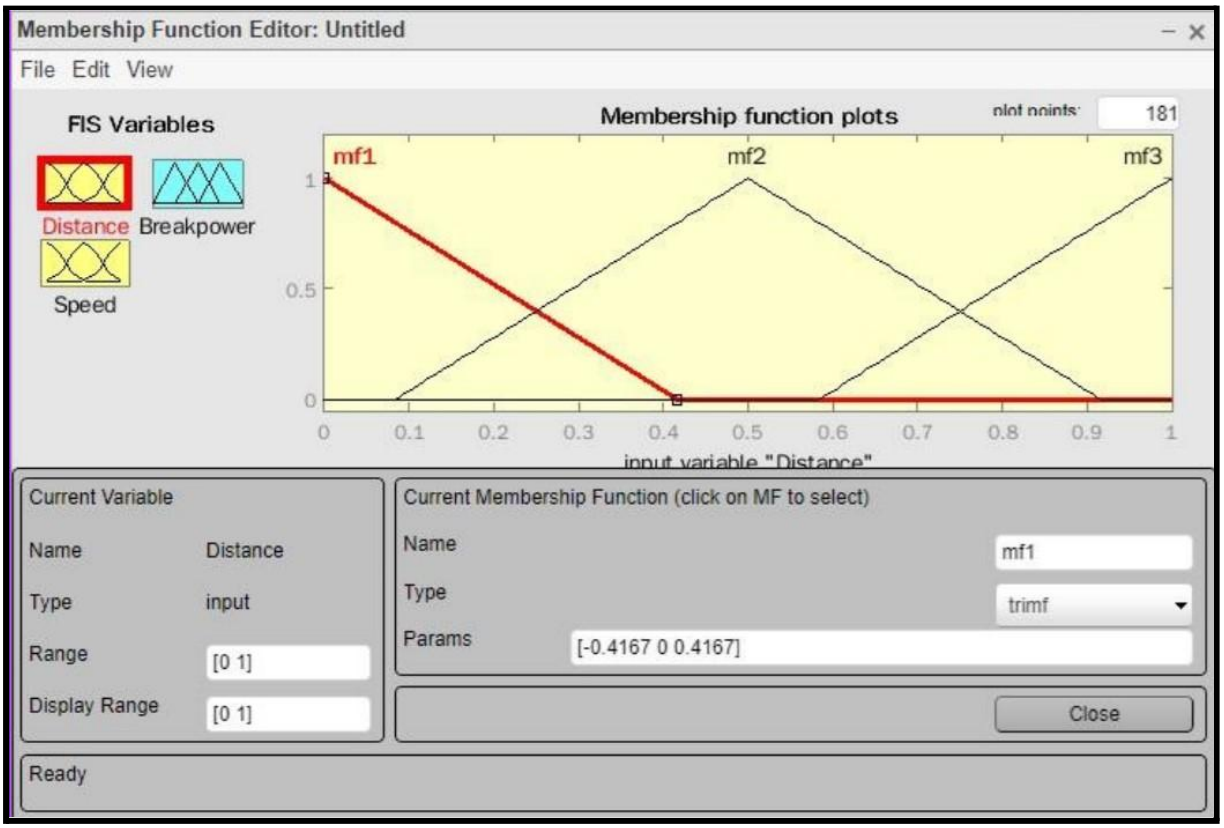
- Initialize with the command "fuzzy"

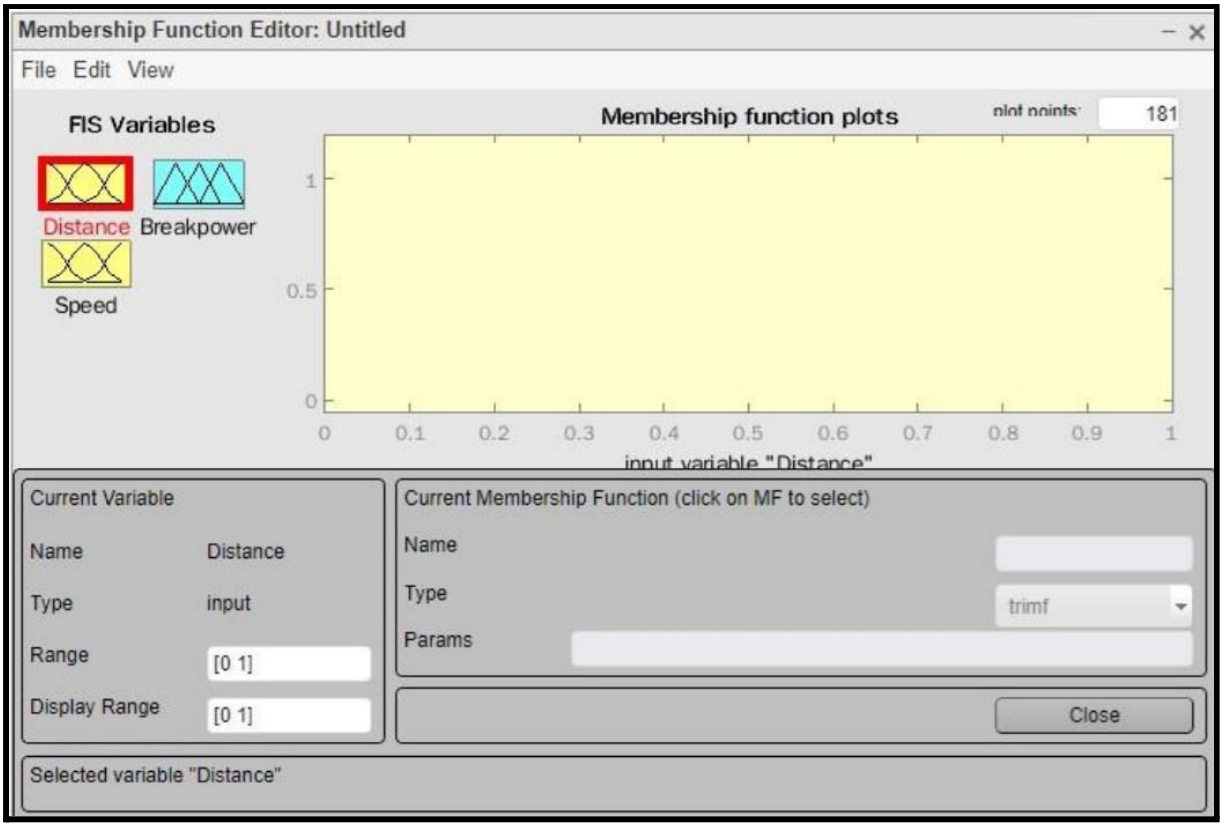
```
>> fuzzy
>>
```

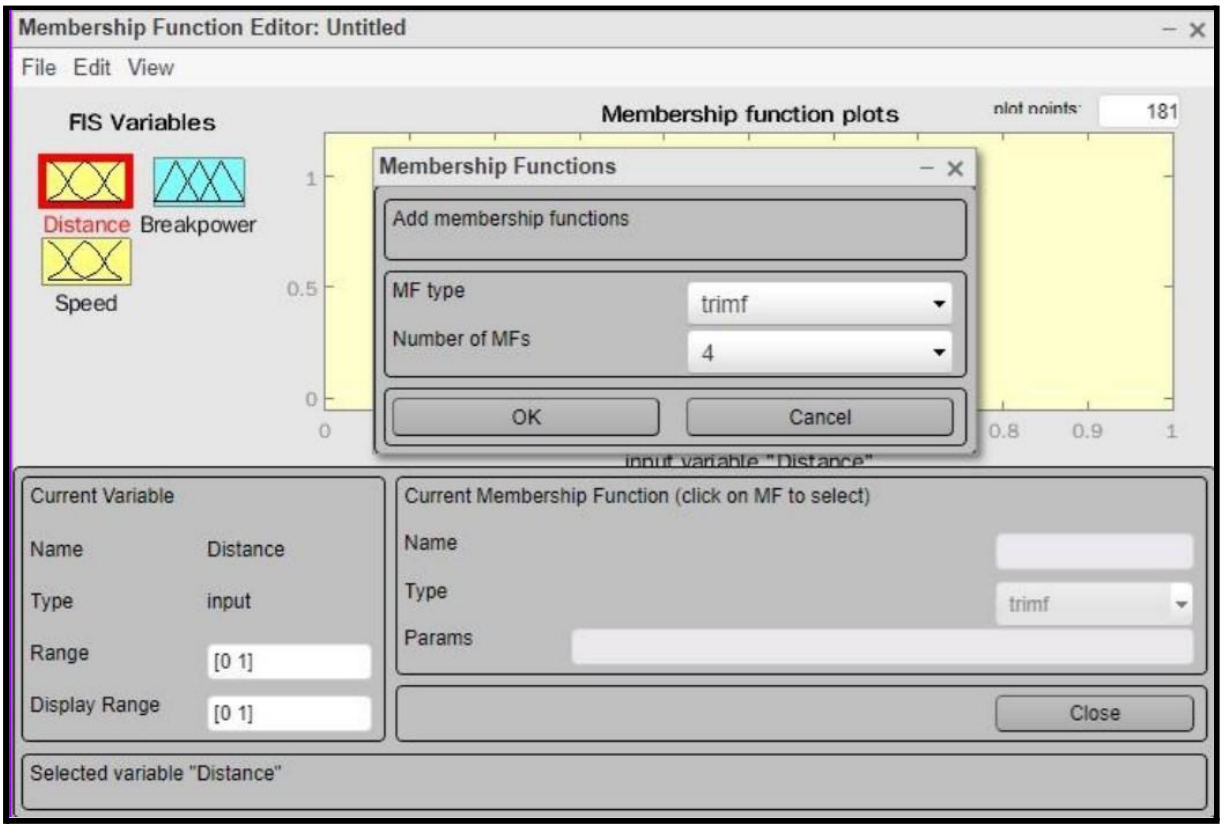

Fuzzy Logic Designer: Untitled
File Edit View
input1
Untitled
(mamdani)
output1
FIS Name: Untitled
FIS Type: mamdani
And method min
Or method max
Implication min
Aggregation max
Defuzzification centroid
Current Variable
Name input1
Type input
Range [0 1]
Close
System "Untitled": 1 input, 1 output, and 0 rules

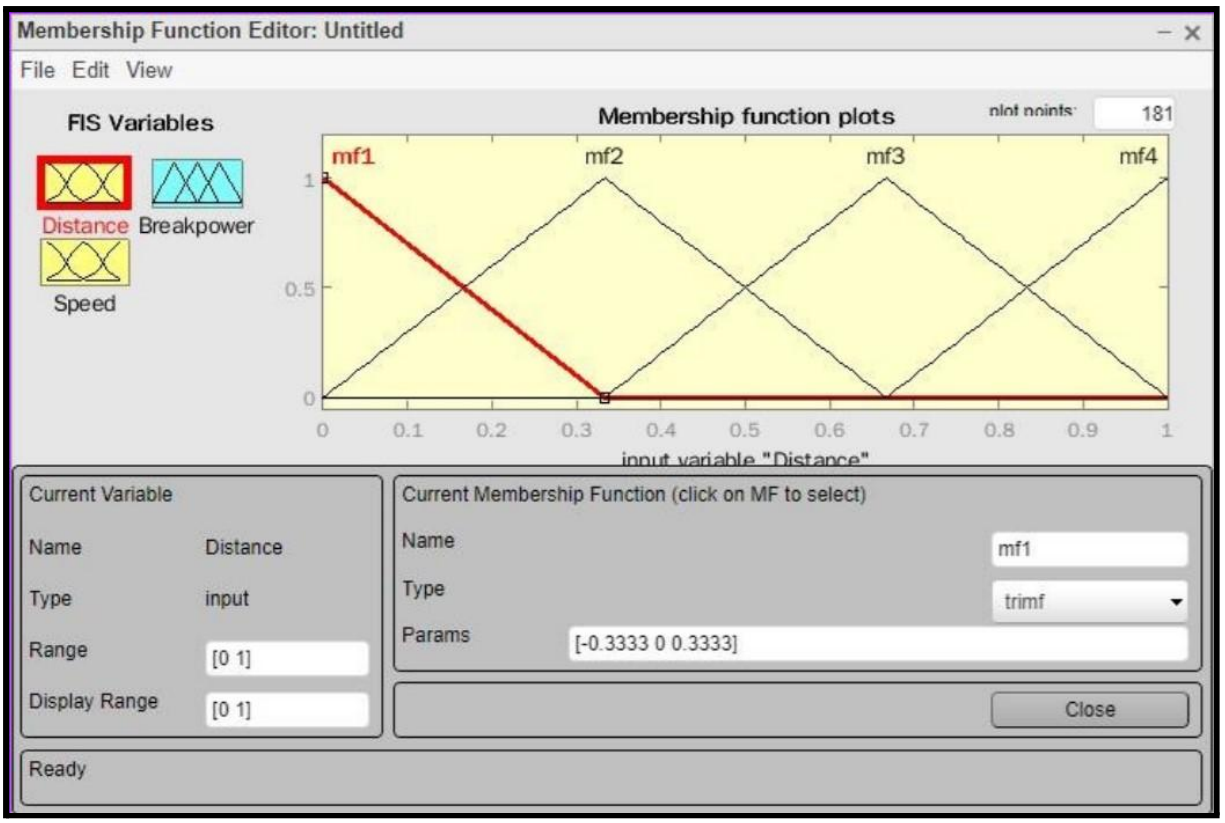

Fuzzy Logic Designer: Untitled
File Edit View
input1
Untitled
(mamdani)
output1
FIS Name: Untitled
FIS Type: mamdani
And method min
Or method max
Implication min
Aggregation max
Defuzzification centroid
Current Variable
Name input1
Type input
Range [0 1]
Close
Opening Membership Function Editor

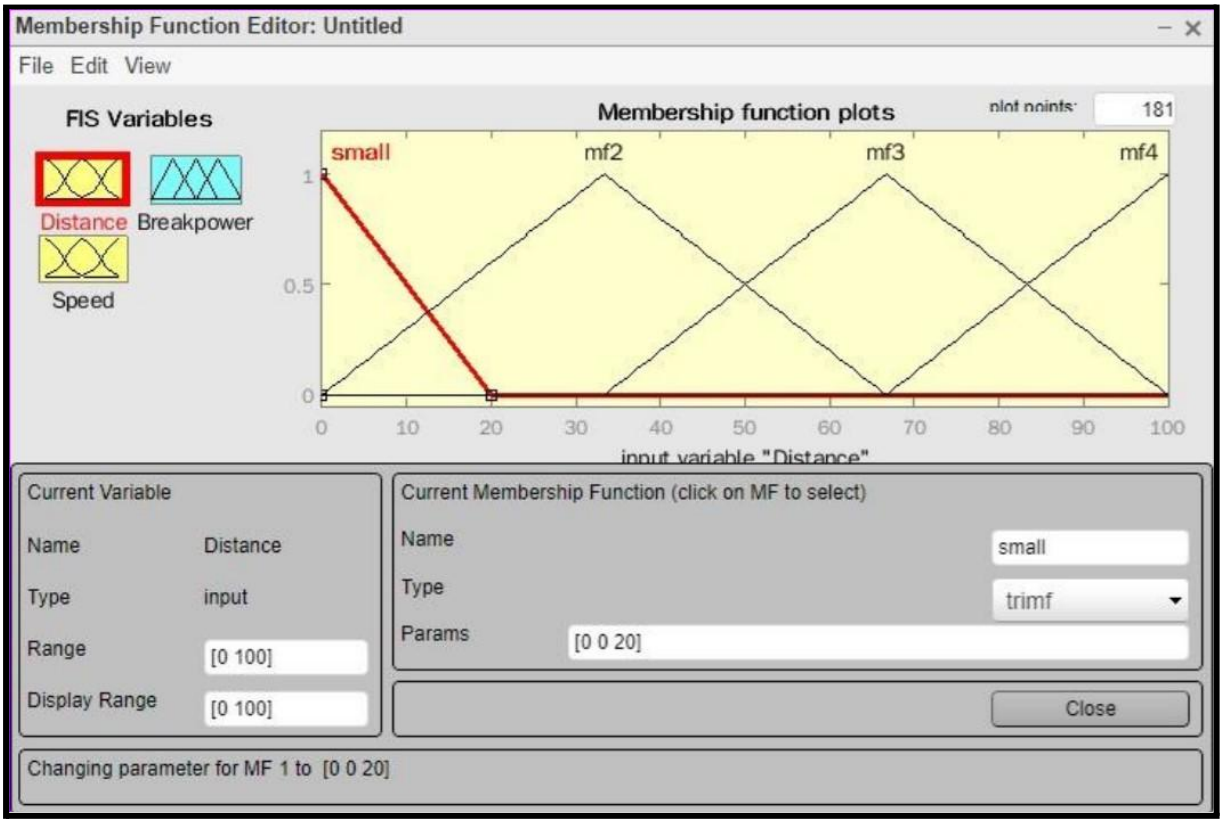

Fuzzy Logic Designer: Untitled
File Edit View
Distance
Speed
Untitled
(mamdani)
Breakpower
FIS Name: Untitled
FIS Type: mamdani
And method min
Or method max
Implication min
Aggregation max
Defuzzification centroid
Current Variable
Name Breakpower
Type output
Range [0 1]
Close
Renaming output variable 1 to "Breakpower"

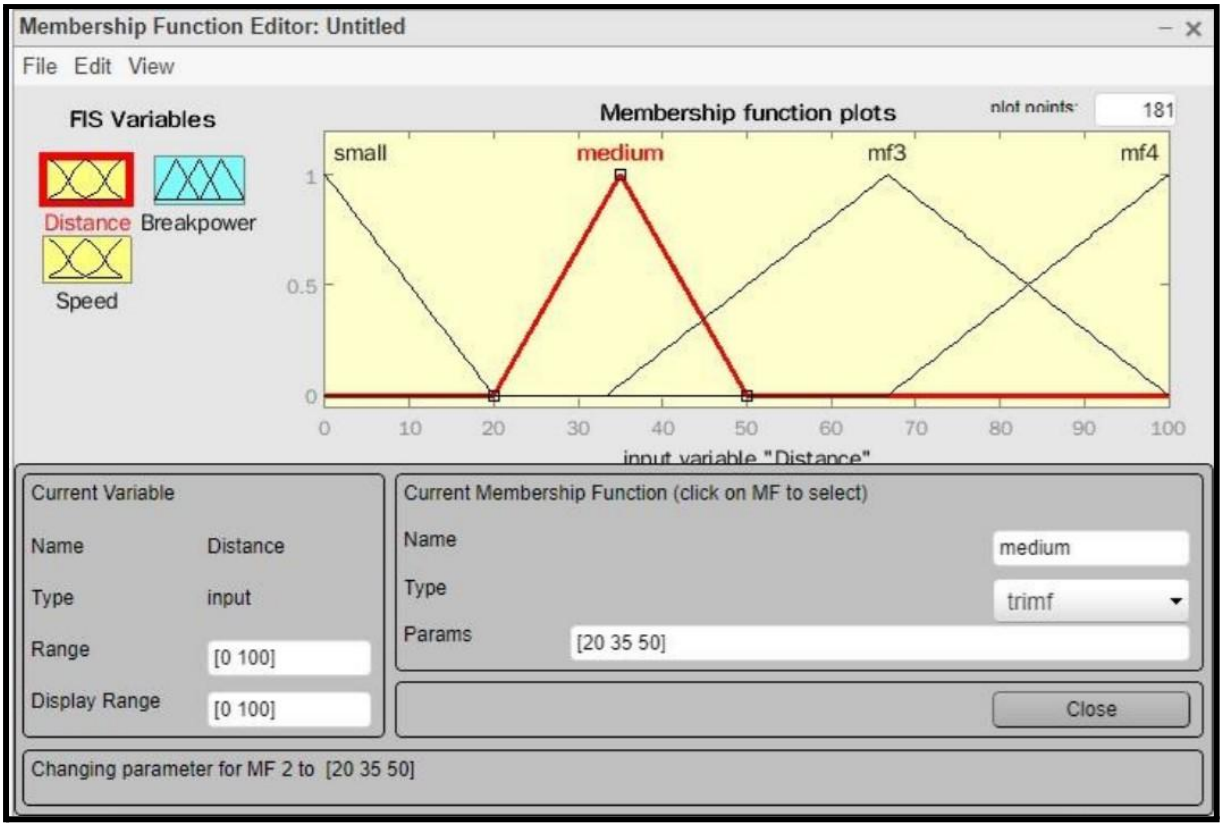

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
mf1
mf2
mf3
input variable "Distance"
Current Variable
Name Distance
Type input
Range [0 1]
Display Range [0 1]
Current Membership Function (click on MF to select)
Name mf1
Type trimf
Params [-0.4167 0 0.4167]
Close
Ready

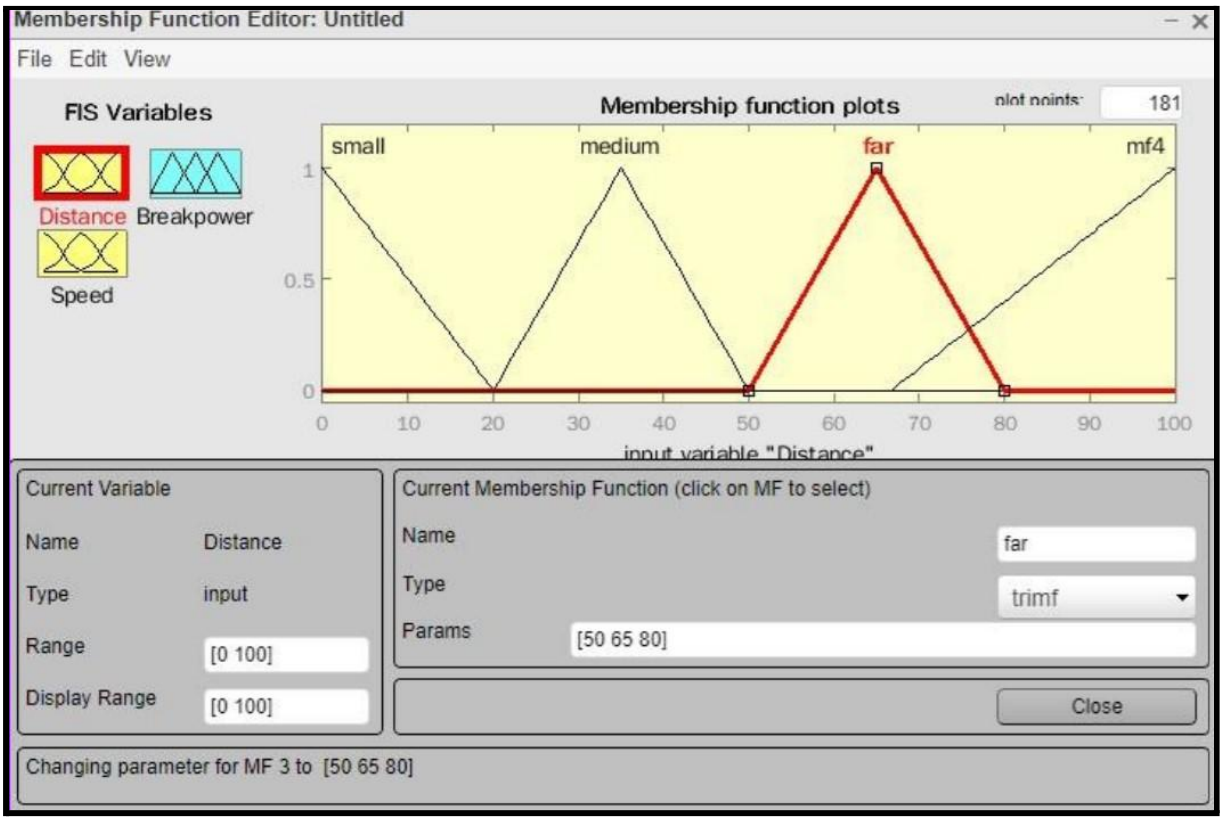

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
1
0.5
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
input variable "Distance"
Current Variable
Name Distance
Type input
Range [0 1]
Display Range [0 1]
Current Membership Function (click on MF to select)
Name
Type trimf
Params
Close
Selected variable "Distance"

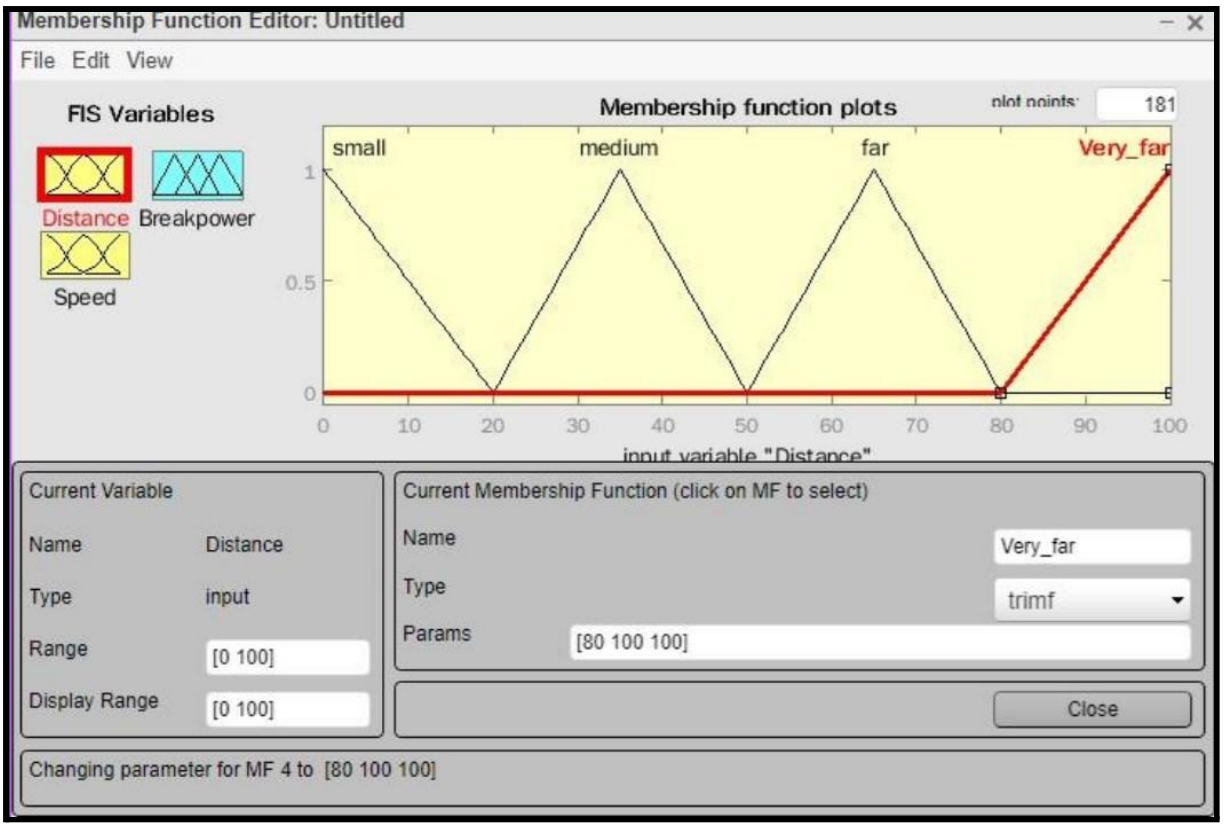

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
Membership Functions
Add membership functions
MF type trimf
Number of MFs 4
OK
Cancel
1
0.5
0
0 0.8 0.9 1
input variable "Distance"
Current Variable
Name Distance
Type input
Range [0 1]
Display Range [0 1]
Current Membership Function (click on MF to select)
Name
Type trimf
Params
Close
Selected variable "Distance"

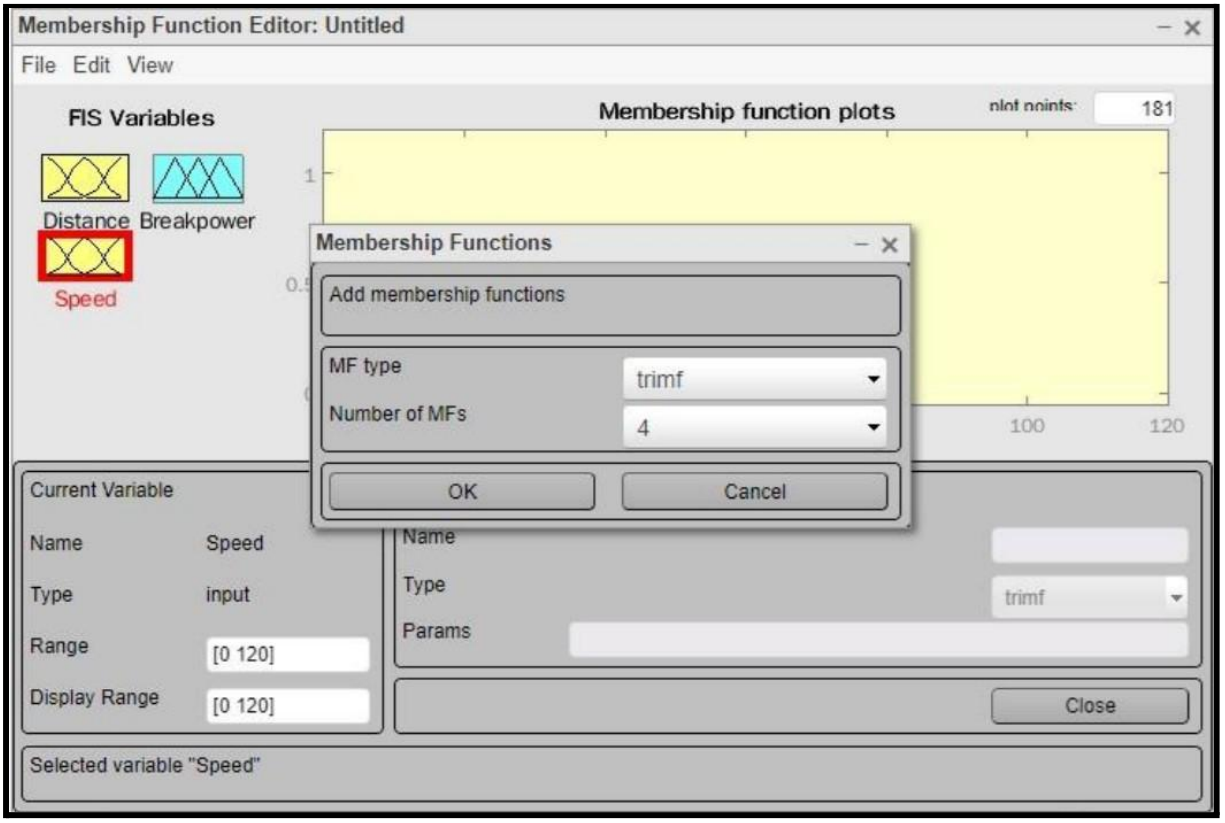

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
mf1
mf2
mf3
mf4
input variable "Distance"
Current Variable
Name Distance
Type input
Range [0 1]
Display Range [0 1]
Current Membership Function (click on MF to select)
Name mf1
Type trimf
Params [-0.3333 0 0.3333]
Close
Ready

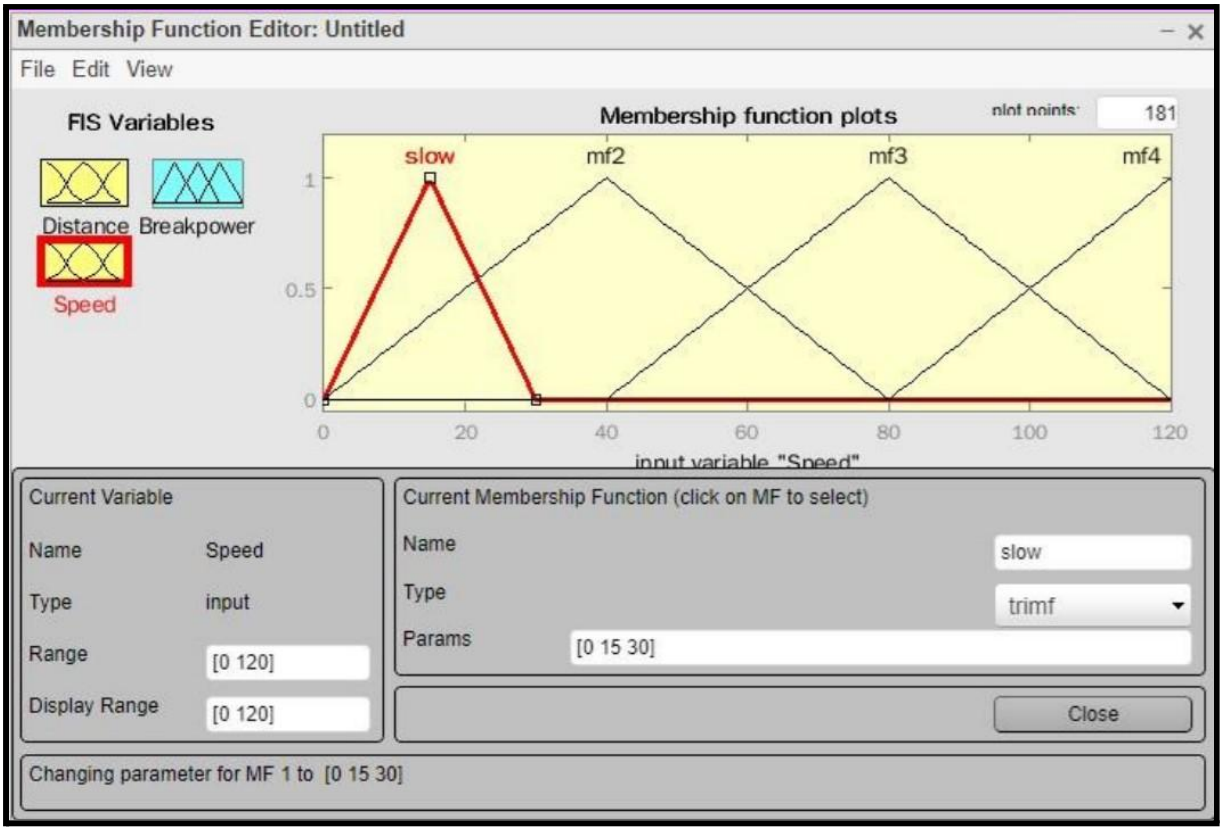

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
small
mf2
mf3
mf4
input variable "Distance"
Current Variable
Name Distance
Type input
Range [0 100]
Display Range [0 100]
Current Membership Function (click on MF to select)
Name small
Type trimf
Params [0 0 20]
Close
Changing parameter for MF 1 to [0 0 20]

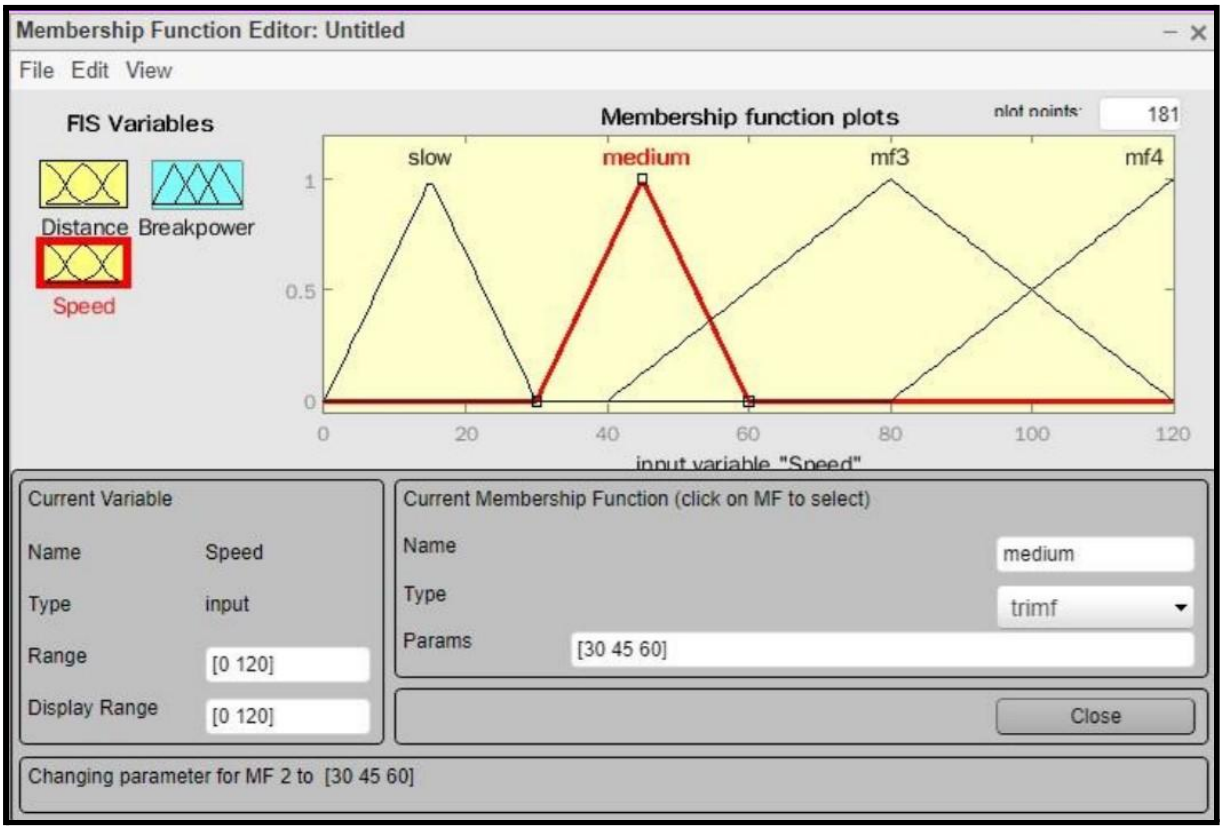

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
small
medium
mf3
mf4
input variable "Distance"
Current Variable
Name Distance
Type input
Range [0 100]
Display Range [0 100]
Current Membership Function (click on MF to select)
Name medium
Type trimf
Params [20 35 50]
Close
Changing parameter for MF 2 to [20 35 50]

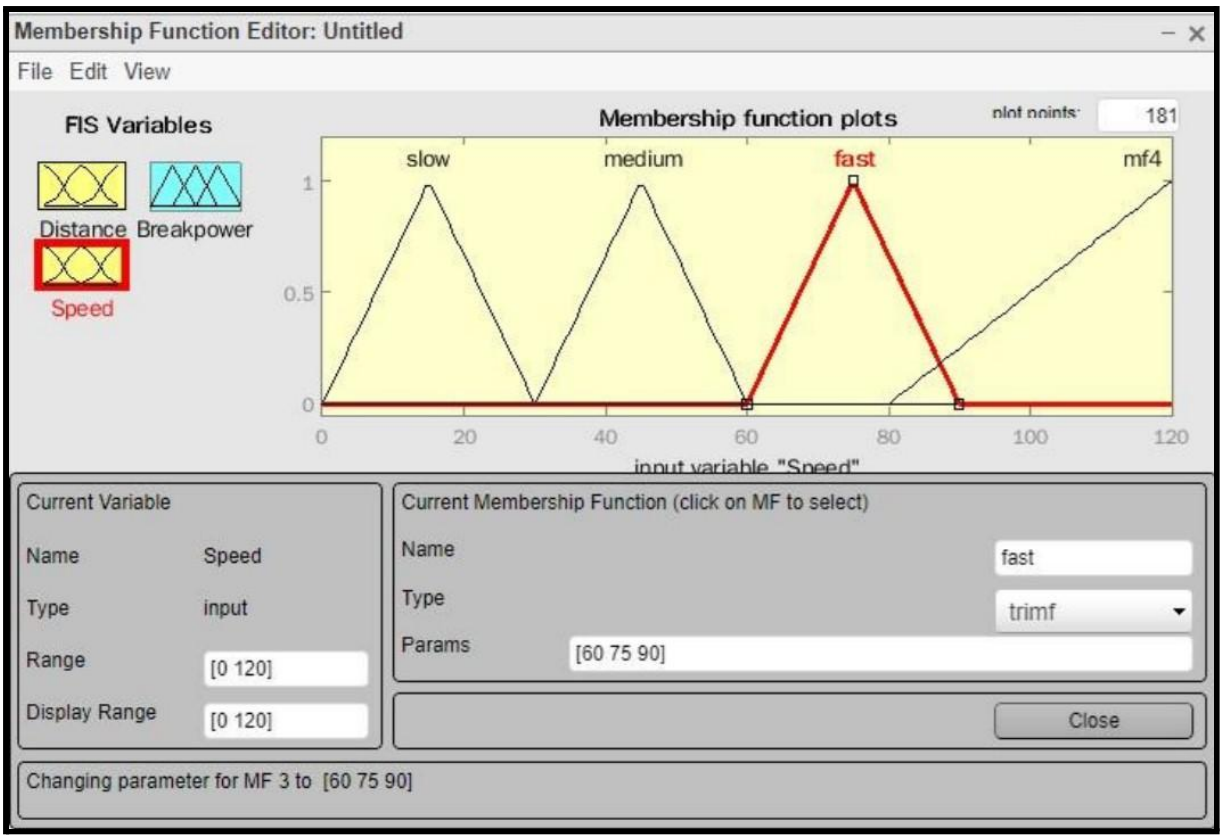

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
small
medium
far
mf4
input variable "Distance"
Current Variable
Name Distance
Type input
Range [0 100]
Display Range [0 100]
Current Membership Function (click on MF to select)
Name far
Type trimf
Params [50 65 80]
Close
Changing parameter for MF 3 to [50 65 80]

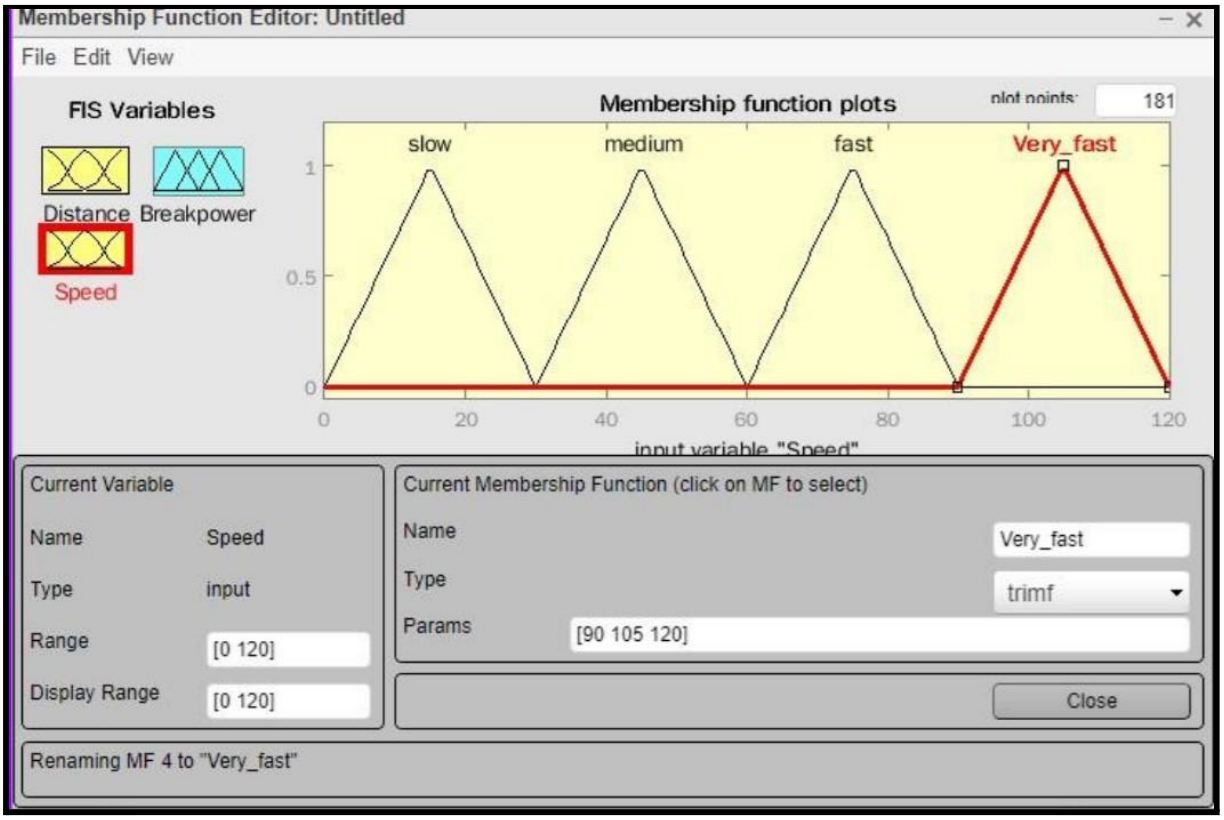

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
small
medium
far
Very_far
input variable "Distance"
Current Variable
Name Distance
Type input
Range [0 100]
Display Range [0 100]
Current Membership Function (click on MF to select)
Name Very_far
Type trimf
Params [80 100 100]
Close
Changing parameter for MF 4 to [80 100 100]

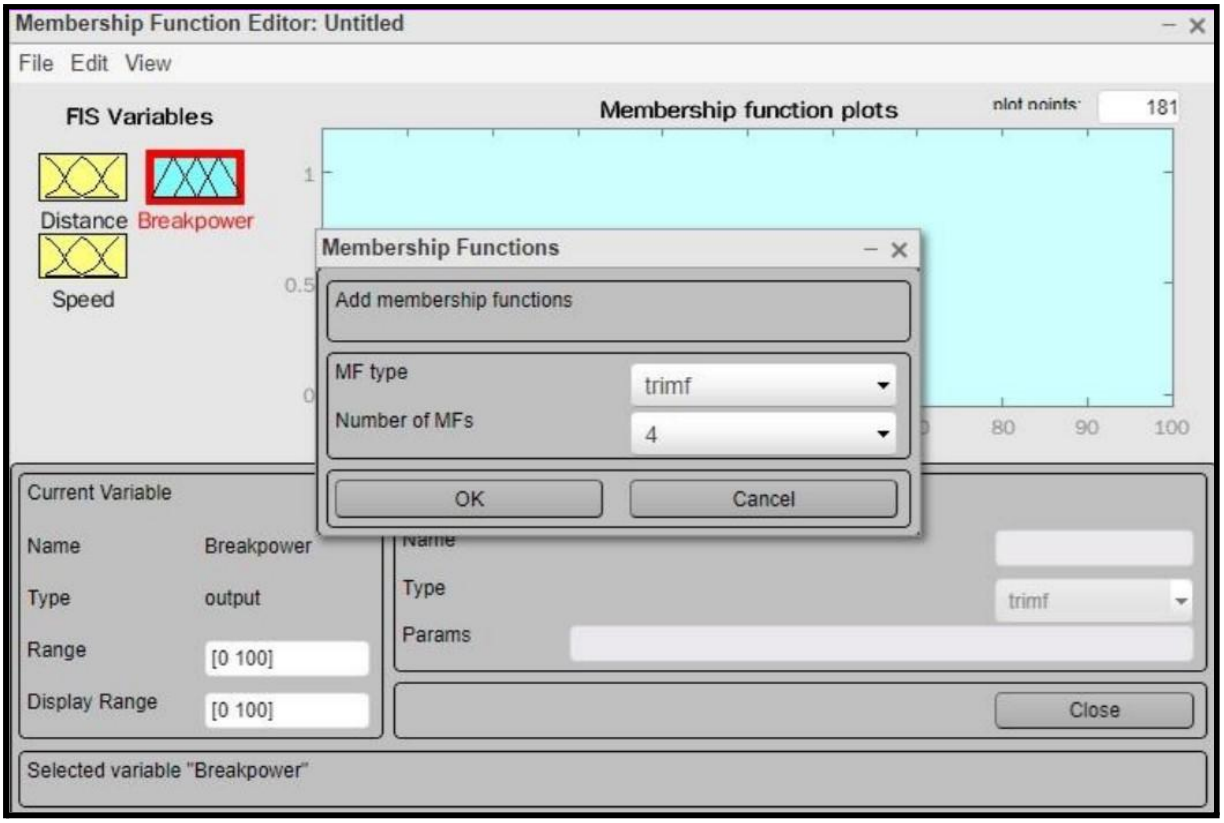

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
Membership Functions
Add membership functions
MF type
trimf
Number of MFs
4
OK
Cancel
Current Variable
Name Speed
Type input
Range [0 120]
Display Range [0 120]
Name
Type
trimf
Params
Close
Selected variable "Speed"

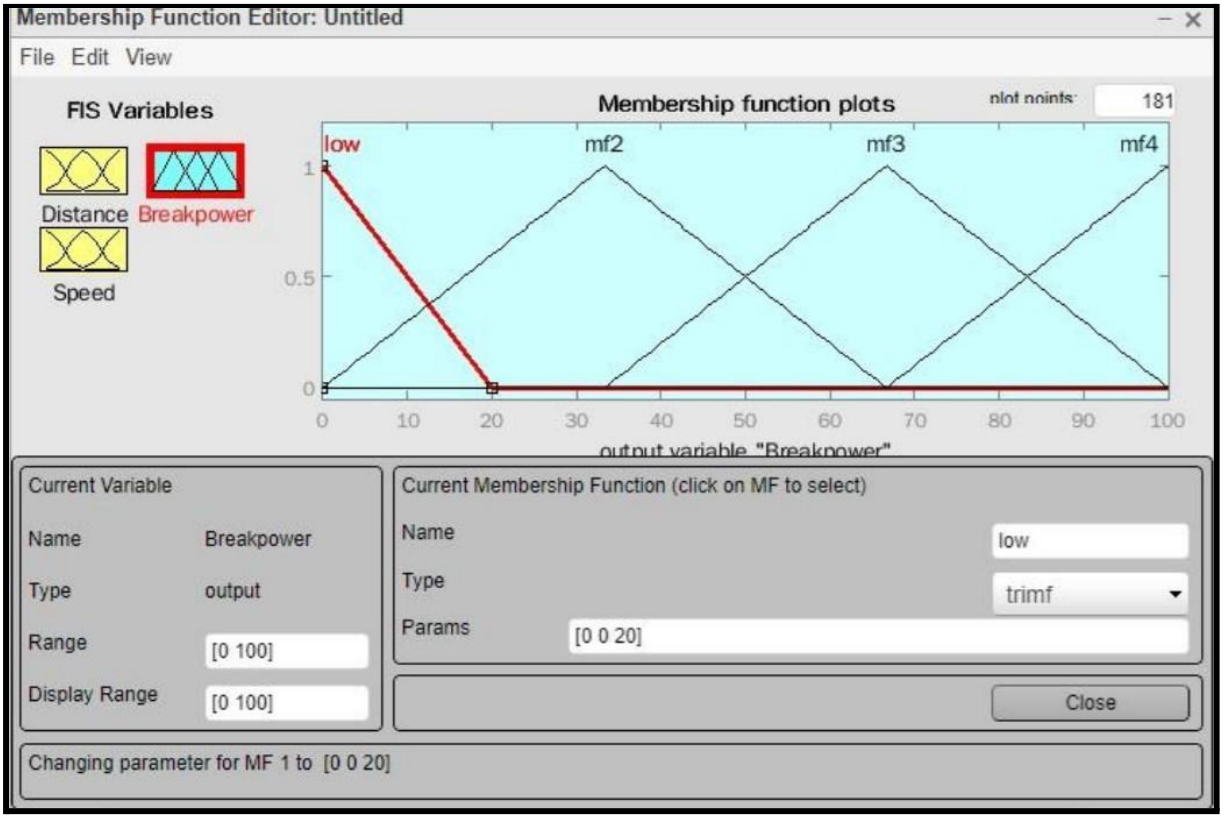

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
slow
mf2
mf3
mf4
1
0.5
0
0 20 40 60 80 100 120
input variable "Speed"
Current Variable
Name Speed
Type input
Range [0 120]
Display Range [0 120]
Current Membership Function (click on MF to select)
Name slow
Type trimf
Params [0 15 30]
Close
Changing parameter for MF 1 to [0 15 30]

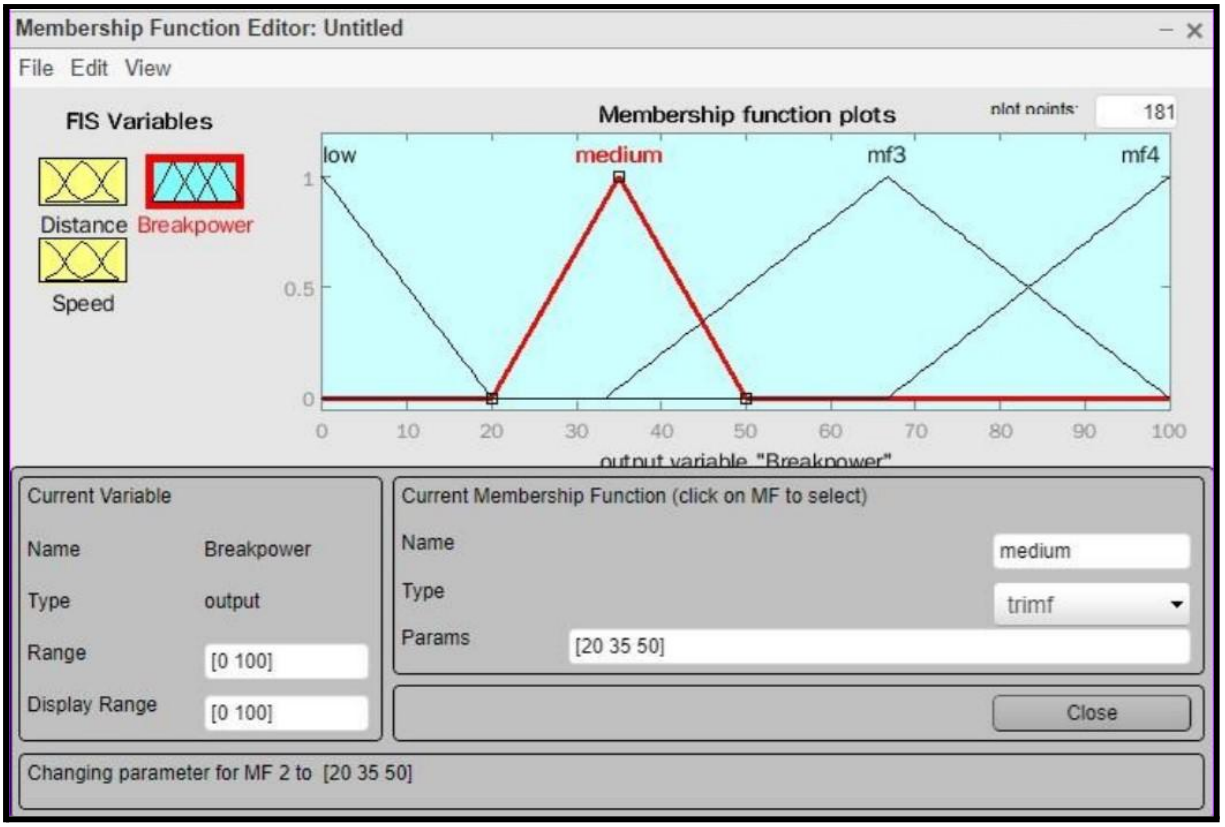

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
slow
medium
mf3
mf4
1
0.5
0
0 20 40 60 80 100 120
input variable "Speed"
Current Variable
Name Speed
Type input
Range [0 120]
Display Range [0 120]
Current Membership Function (click on MF to select)
Name medium
Type trimf
Params [30 45 60]
Close
Changing parameter for MF 2 to [30 45 60]

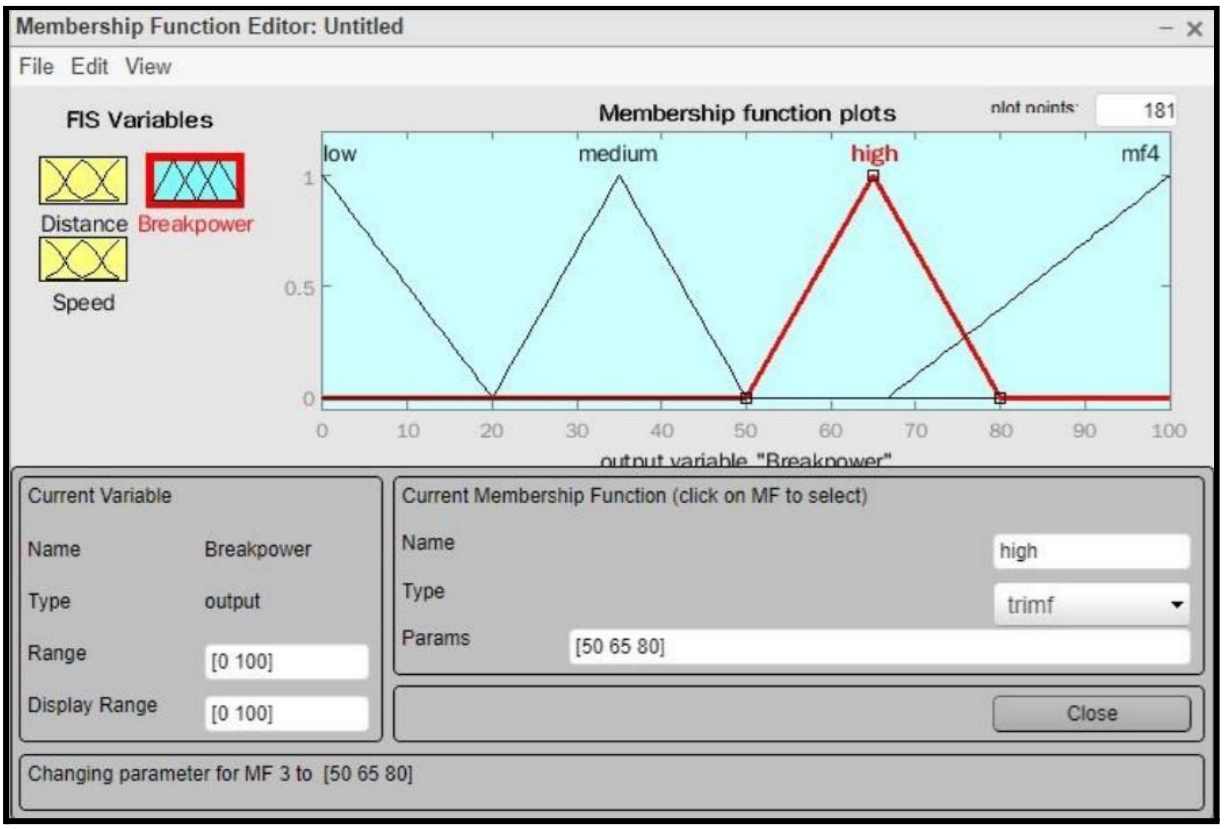

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
slow
medium
fast
mf4
input variable "Speed"
Current Variable
Name
Speed
Type
input
Range
[0 120]
Display Range
[0 120]
Current Membership Function (click on MF to select)
Name
fast
Type
trimf
Params
[60 75 90]
Close
Changing parameter for MF 3 to [60 75 90]

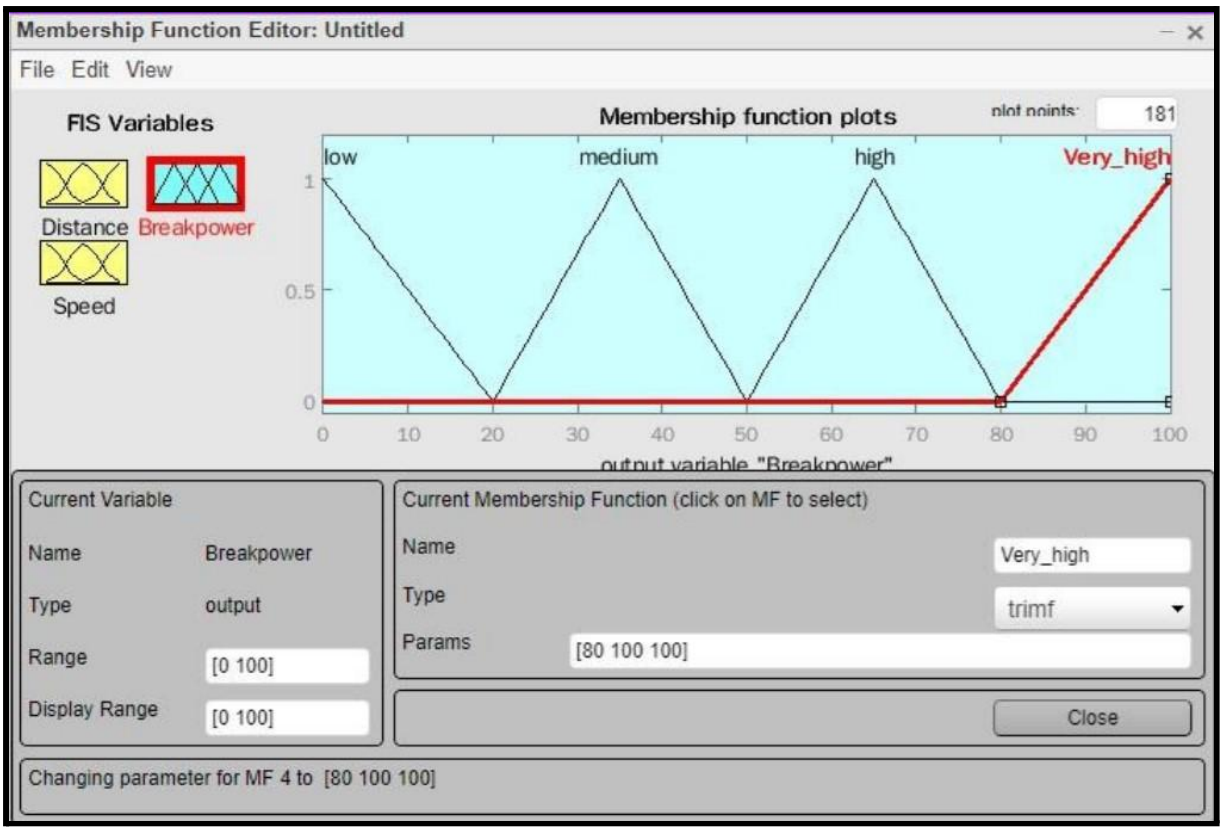

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
slow
medium
fast
Very_fast
input variable "Speed"
Current Variable
Name
Speed
Type
input
Range
[0 120]
Display Range
[0 120]
Current Membership Function (click on MF to select)
Name
Very_fast
Type
trimf
Params
[90 105 120]
Close
Renaming MF 4 to "Very_fast"

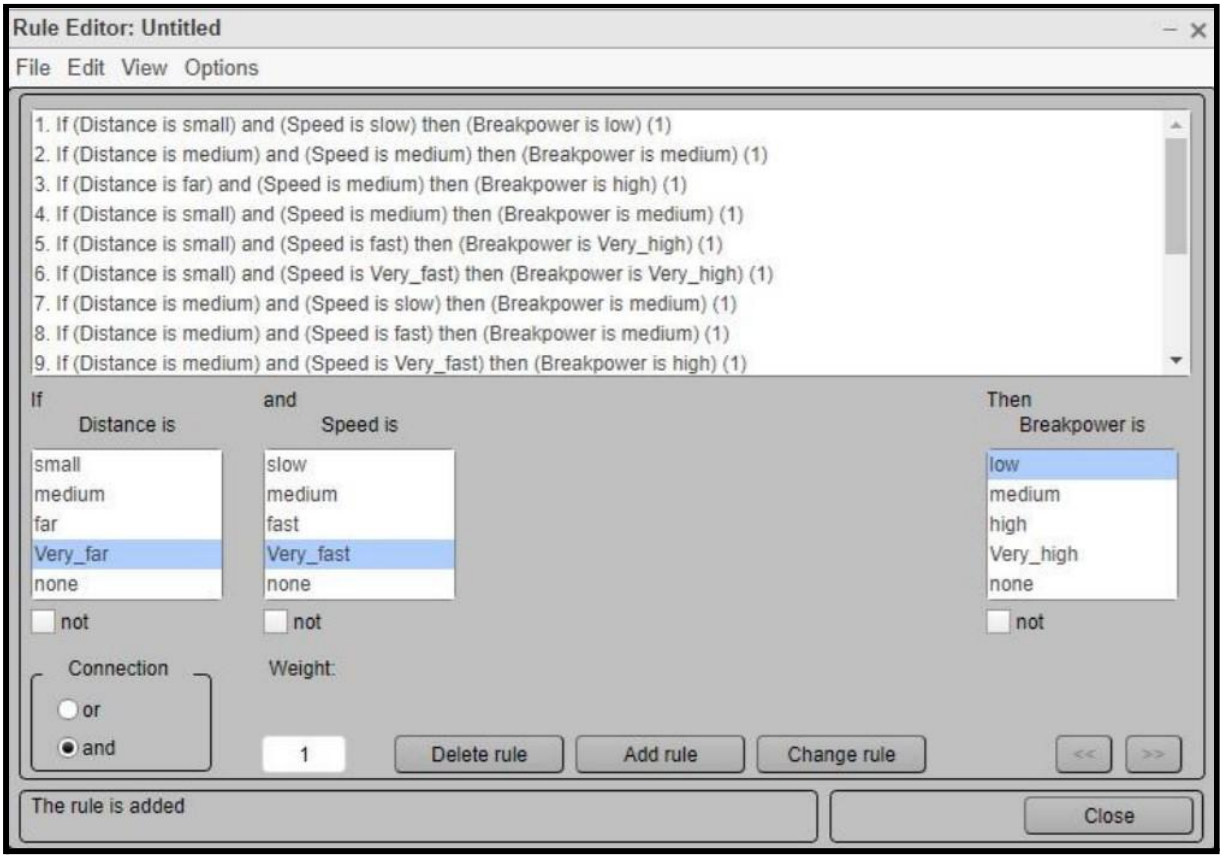

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
Membership Functions
Add membership functions
MF type
trimf
Number of MFs
4
OK
Cancel
Current Variable
Name
Breakpower
Type
output
Range
[0 100]
Display Range
[0 100]
Type
trimf
Params
Close
Selected variable "Breakpower"

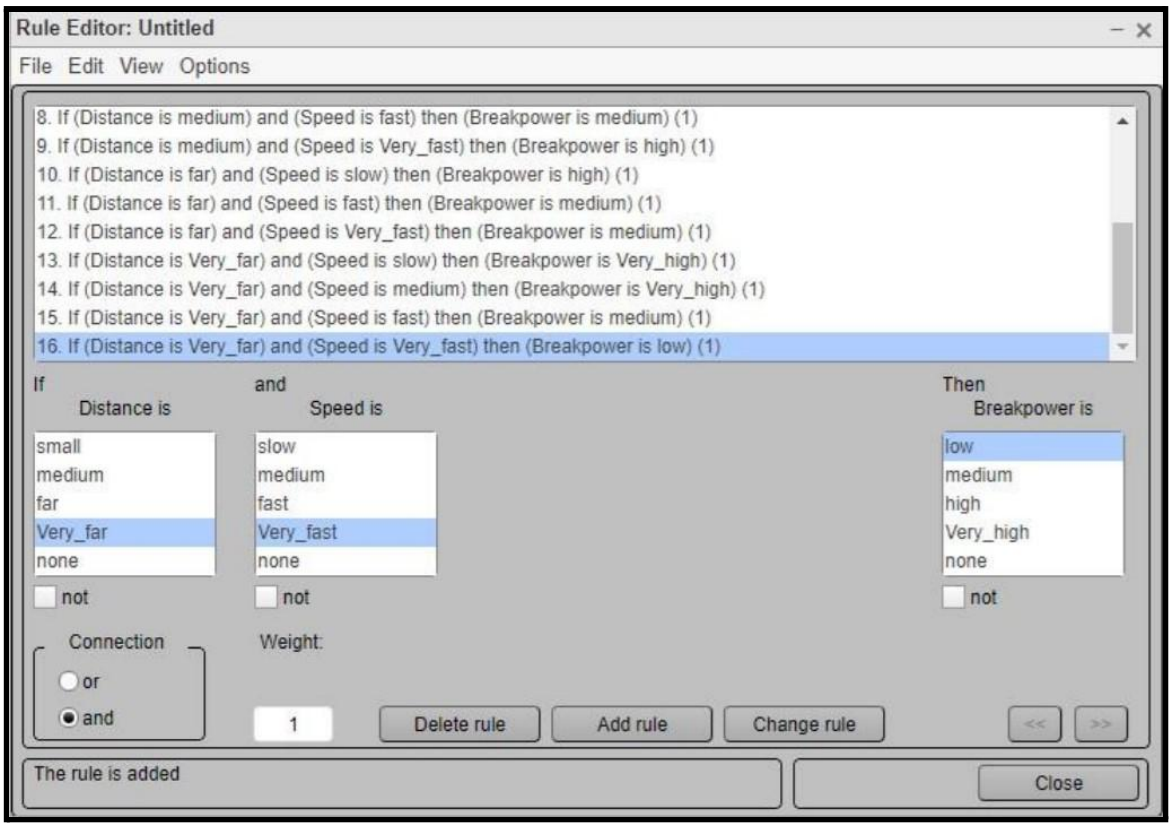

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
low
mf2
mf3
mf4
output variable "Breakpower"
Current Variable
Name
Breakpower
Type
output
Range
[0 100]
Display Range
[0 100]
Current Membership Function (click on MF to select)
Name
low
Type
trimf
Params
[0 0 20]
Close
Changing parameter for MF 1 to [0 0 20]

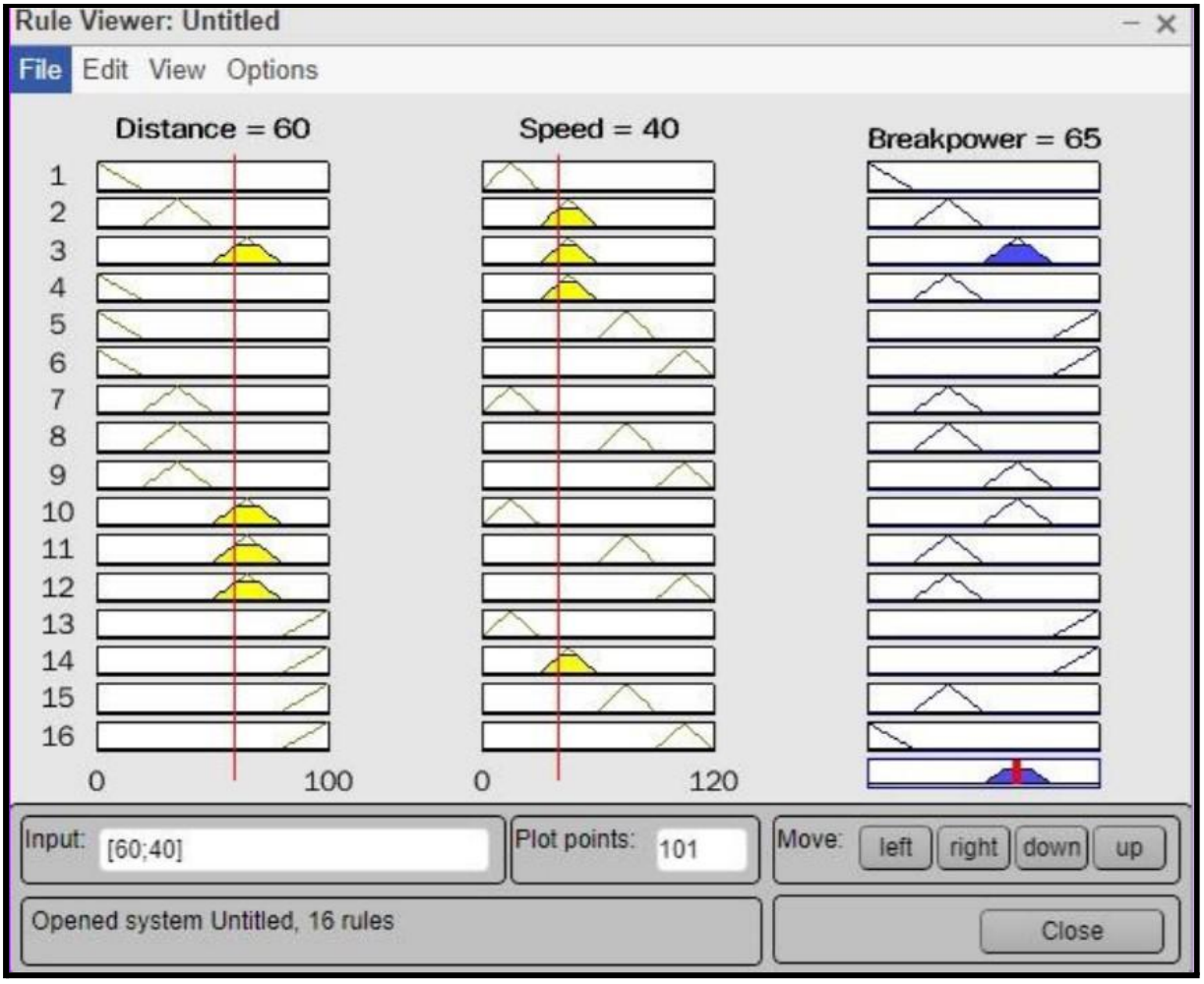

Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
low
medium
mf3
mf4
output variable "Breakpower"
Current Variable
Name Breakpower
Type output
Range [0 100]
Display Range [0 100]
Current Membership Function (click on MF to select)
Name medium
Type trimf
Params [20 35 50]
Close
Changing parameter for MF 2 to [20 35 50]


Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points: 181
low
medium
high
mf4
output variable "Breakpower"
Current Variable
Name Breakpower
Type output
Range [0 100]
Display Range [0 100]
Current Membership Function (click on MF to select)
Name high
Type trimf
Params [50 65 80]
Close
Changing parameter for MF 3 to [50 65 80]


Membership Function Editor: Untitled
File Edit View
FIS Variables
Distance
Breakpower
Speed
Membership function plots
plot points:
181
low
medium
high
Very_high
output variable "Breakpower"
Current Variable
Name
Breakpower
Type
output
Range
[0 100]
Display Range
[0 100]
Current Membership Function (click on MF to select)
Name
Very_high
Type
trimf
Params
[80 100 100]
Close
Changing parameter for MF 4 to [80 100 100]


Rule Editor: Untitled
File Edit View Options
1. If (Distance is small) and (Speed is slow) then (Breakpower is low) (1)
2. If (Distance is medium) and (Speed is medium) then (Breakpower is medium) (1)
3. If (Distance is far) and (Speed is medium) then (Breakpower is high) (1)
4. If (Distance is small) and (Speed is medium) then (Breakpower is medium) (1)
5. If (Distance is small) and (Speed is fast) then (Breakpower is Very_high) (1)
6. If (Distance is small) and (Speed is Very_fast) then (Breakpower is Very_high) (1)
7. If (Distance is medium) and (Speed is slow) then (Breakpower is medium) (1)
8. If (Distance is medium) and (Speed is fast) then (Breakpower is medium) (1)
9. If (Distance is medium) and (Speed is Very_fast) then (Breakpower is high) (1)
If
Distance is
small
medium
far
Very_far
none
not
and
Speed is
slow
medium
fast
Very_fast
none
not
Then
Breakpower is
low
medium
high
Very_high
none
not
Connection
or
and
Weight:
1
Delete rule
Add rule
Change rule
<<
>>
The rule is added
Close


Rule Editor: Untitled
File Edit View Options
8. If (Distance is medium) and (Speed is fast) then (Breakpower is medium) (1)
9. If (Distance is medium) and (Speed is Very_fast) then (Breakpower is high) (1)
10. If (Distance is far) and (Speed is slow) then (Breakpower is high) (1)
11. If (Distance is far) and (Speed is fast) then (Breakpower is medium) (1)
12. If (Distance is far) and (Speed is Very_fast) then (Breakpower is medium) (1)
13. If (Distance is Very_far) and (Speed is slow) then (Breakpower is Very_high) (1)
14. If (Distance is Very_far) and (Speed is medium) then (Breakpower is Very_high) (1)
15. If (Distance is Very_far) and (Speed is fast) then (Breakpower is medium) (1)
16. If (Distance is Very_far) and (Speed is Very_fast) then (Breakpower is low) (1)
If
Distance is
small
medium
far
Very_far
none
not
and
Speed is
slow
medium
fast
Very_fast
none
not
Then
Breakpower is
low
medium
high
Very_high
none
not
Connection
or
and
Weight:
1
Delete rule
Add rule
Change rule
<<
>>
The rule is added
Close


Rule Viewer: Untitled
File Edit View Options
Distance = 60
Speed = 40
Breakpower = 65
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
0
100
0
120
Input: [60;40]
Plot points: 101
Move: left right down up
Opened system Untitled, 16 rules
Close

B.3 Observations and learning:

We utilized fuzzy logic concepts and heuristics based on the human experience. We generalized in order to provide acceptable rules for inference systems. In addition, we showed fuzzy inference systems.

B.4 Conclusion:

Hence, we were able to implement the Fuzzy Controller.

B.5 Question of Curiosity

Q1) What is the sequence of steps taken in designing a fuzzy logic machine?

Ans:

Following is the sequence for designing a fuzzy logic machine:

Fuzzification->Rule Evaluation->Defuzzification

When designing a fuzzy logic, we first have to define the fuzzy sets and make appropriate member functions. The rule evaluation comes in which matches the sets to its corresponding rules.

Q2) What is the reason that logic function has rapidly become one of the most

successful technologies for developing sophisticated control systems?

Ans:

There are mainly two reasons:

1. Fuzzy logic applies the concept of 'certain degree' which is similar to the way human beings think. Instead of just being either true or false, fuzzy logic can be true partially and also false partially at the same time. This is similar to the human mind.
2. Fuzzy logic can uses exact points representing to what degree an event occurs and with fuzzy rules, it generates precise outcomes.