**Assignment -8**

**Title:** To study and implement the Defuzzification methods in MATLAB.

**Theory:**

* **Defuzzification:**

Conversion of Fuzzy set into a single crisp value is called Defuzzification.The set of rules is applied to the fuzzified input. The output of each rule is fuzzy. These fuzzy outputs need to be converted into a scalar output quantity so that the nature of the action to be performed can be determined by the system. The process of converting the fuzzy output is called defuzzification. Before an output is defuzzified all the fuzzy outputs of the system are aggregated with an union operator. The union is the *max* of the set of given membership functions. There are many defuzzification techniques but primarily only three of them are in common use. These defuzzification techniques are discussed below in detail.

**Types Of Defuzzification Techniques**:

1. **Centroid Defuzzification Technique**

This method is also known as center of gravity or center of area defuzzification. This technique was developed by Sugeno in 1985. This is the most commonly used technique and is very accurate. The centroid defuzzification technique can be expressed as

|  |  |
| --- | --- |
| http://enpub.fulton.asu.edu/PowerZone/FuzzyLogic/chapter%206/Eq6-3.gif | --(equ.2) |

where***x\**** is the defuzzified output,  ***µi*(*x*)** is the aggregated membership function and ***x*** is the output variable. The only disadvantage of this method is that it is computationally difficult for complex membership functions.

Consider following three membership functions.



Then using mean-max membership these membership functions are combined to form a fuzzy rule set.



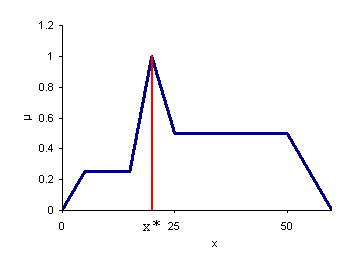
Above reultant is divided in the shapes of triangles and trapezoids. Centroids and area for each shape. Defuzzified value is determined using equ.2.

**2. Maximum Defuzzification Technique**

This method gives the output with the highest membership function. This defuzzification technique is very fast but is only accurate for peaked output. This technique is given by algebraic expression as

http://enpub.fulton.asu.edu/PowerZone/FuzzyLogic/chapter%206/Eq6-2.gif; for all *x http://enpub.fulton.asu.edu/PowerZone/FuzzyLogic/chapter%206/epsilon.gif X*  --(equ.1)

where *x*\* is the defuzzified value. This is shown graphically in Figure.



**3. Weighted Average Defuzzification Technique:**

In this method the output is obtained by the weighted average of the each output of the set of rules stored in the knowledge base of the system. The weighted average defuzzification technique can be expressed as

|  |  |
| --- | --- |
| http://enpub.fulton.asu.edu/PowerZone/FuzzyLogic/chapter%206/Eq6-4.gif --(equ.3) . |  |
|  |  |

where ***x\**** is the defuzzified output, ***mi*** is the membership of the output of each rule, and ***wi*** is the weight associated with each rule.

**4. Mean-Max Membership Defuzzification Technique:**

In this method mean of the maximum values of membership function is considered as defuzzified value for the associated fuzzy set rule.

--(equ.4)

Where is defuzzified output, is maximum value of membership rule.

**5.** First or Last of Membership Defuzzification technique.

**Algorithm:**

Defuzzification using Center of Gravity Method:

1. Enter the membership sets.
2. Using mean-max membership or max membership or First(or Last) membership form the fuzzy set of given membership functions.Divide fuzzy set in the shapes of triangles and trapezoids.
3. Calculate center of gravity and area for each shape.
4. Using **(equ.2)** determine defuzzified value.

**FAQ’s:**

1. Define Fuzzification.
2. Define Defuzzification.
3. Compare various defuzzification methods.
4. Define lambda-cuts for fuzzy set.