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RESEARCH ARTICLE

DESIGNING AND SIMULATING OF SOFT COMPUTING METHOD ORIENTED ON FUZZY LOGIC SYSTEMS

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ABSTRACT

The expression of 'fuzzy' alludes to the capacity of managing uncertain or obscure inputs. Rather than utilizing complex numerical mathematical statements, fuzzy logic utilizes linguistic depictions to characterize the relationship between the input data and the output activity. In engineering systems, fuzzy logic gives an advantageous and easy to understand front-end to create control projects, helping creators to focus on the functional objectives, not on the mathematics. In this paper the basic content about the way of fuzziness, fuzzy operations and fuzzy rules are performed.

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INTRODUCTION

The idea of Fuzzy Logic (FL) was brought about by Lotfi Zadeh, (Zadeh, 1965) an professor at the University of California at Berkley, and displayed not as a control technique, but rather as a method for allowing to handling the incomplete set membership as opposed to crisp set (Mamdani and Assilian, 1975) membership or non-membership. In this connection, Fuzzy Logic is a critical thinking control framework approach that fits execution in frameworks extending from straightforward, little, implanted smaller scale controllers to vast, organized, multi-channel Personal Computer or workstation-based information obtaining and control frameworks. It can be actualized in equipment, programming, or a blend of both. Fuzzy Logic gives a straightforward approach to touch base at an unequivocal conclusion based upon ambiguous, vague, noisy, or missing data. Fuzzy Logic's (Takagi and Sugeno, 1985) way to deal with control issues copies how a man would decide, just much quicker. Fuzzy Logic joins a straightforward, rule-based IF X AND Y THEN Z way to deal with a taking care of control issue as opposed to endeavouring to model a framework scientifically. Consider (Ishibuchi *et al*., 1994) what you do in the shower if the temperature is excessively cold and make the water agreeable rapidly with little inconvenience. FL is equipped for emulating this kind of conduct however at high rate. Fuzzy Logic obliges some numerical parameters with a specific end goal to work, for example, what is viewed as huge slip and noteworthy rate-of-progress of-mistake, however correct estimations of these numbers are typically not discriminating unless exceptionally responsive execution is needed in which case observational tuning would focus them (Rojas *et al*., 2000) . The membership function is a graphical representation of the greatness of support of every data.

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It relates a weighting with each of the inputs at are handled, characterize useful cover in the middle of inputs, and eventually decides an output response. The standards utilize the input membership esteem as weighting components to focus their impact on the fuzzy output sets of the final output conclusion. Once the functions are constructed, scaled, and consolidated they are defuzzified (Ishibuchi *et al*., 1995) into a crisp output which drives the framework. There are diverse membership (Wang *et al*., 1992) functions connected with input and output response. The membership functions have the different shapes such as triangular which is regular, however bell, trapezoidal, haversine and exponential have been utilized. More complex functions are conceivable however oblige more worthy figuring overhead to execute.

Design of Fuzzy Inference System

Fuzzy inference is the procedure of defining the mapping from offered information to a yield utilizing fuzzy logic. The procedure of fuzzy inference (Ramjeet Singh Yadav, 2011) includes the membership functions, fuzzy logic operators, (http://xa.yimg.com) and if-then rules.

There are two sorts of fuzzy inference systems that can be executed in the fuzzy logic toolbox in Matlab are Mamdani-type and Sugeno- type. These two sorts of inference systems change to some degree in the way outputs are resolved. Fuzzy inference systems have been effectively connected in fields, for example, programmed control, data classification, decision analysis, expert systems. On account of its multidisciplinary nature, fuzzy inference systems are connected with various names, for example, fuzzy-rule-based systems, fuzzy expert systems, fuzzy modelling, fuzzy associative memory, fuzzy logic controllers, and simply fuzzy systems (John Yen, ?). Mamdani's fuzzy inference system is the most generally seen fuzzy procedure. Mamdani's technique was among the first control frameworks constructed utilizing fuzzy set hypothesis (Berthold and Huber, 1999). It was proposed in 1975 by Ebrahim Mamdani as an endeavour to control a steam motor and boiler combination by synthesizing an arrangement of linguistic control standards acquired from experienced human operators.

Mamdani-type inference, as characterized it for the fuzzy logic toolbox, expects the output membership functions to be fuzzy sets (Bezdek *et al*., 1999). After the aggregation process, there is a fuzzy set for each output variable that needs defuzzification. It's conceivable, and as a rule a great deal more proficient, to utilize a solitary spike as the output membership function instead of a dispersed fuzzy set (Borgelt, 1998). This is now and again known as a singleton output membership function, and it can be considered as a pre-defuzzified fuzzy set. It improves the effectiveness of the defuzzification (Dubois *et al*., 1996) process in light of the fact that it extraordinarily rearranges the calculation needed by the more broad Mamdani inference technique, which finds the centroid of a two-dimensional function. As opposed to coordinating over the two-dimensional function to discover the centroid, utilize the weighted normal of a few information focuses. Sugeno-inference type (Kruse *et al*., 1994) frameworks support this kind of model. When all is said in done, Sugeno-inference systems can be utilized to display any inference system in which the output membership functions are either direct or consistent (Kruse *et al*., 1999).

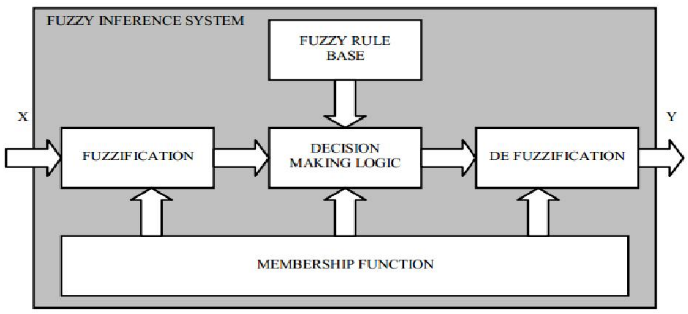


Fig. 1. A process of Fuzzy inference system

Algorithm for Fuzzy Inference System

Step1: Start

Step2: Initialize Name = 'filename' Type = 'mamdani' / 'Tsugeno'

*/ * fuzzification process */*

Step3: Initialize the inputs & outputs by giving the functional methods where

NumInputs = 2 NumOutputs = 2

Step4: Mention the variables for fuzzy operators such as 'And',' Or' where

AndMethod = 'min' OrMethod = 'max' ImpMethod = 'min' AggMethod = 'max'

/ Initialize the defuzzification method */*

DefuzzMethod = 'centroid'

Step5: Giving the Input variables their ranges and membership functions such as

Name = 'temp' Range = (-20 20)

NumMFs = 3

MF1='cold':'trapmf', (-30 -30 -15 0)
MF2='good':'trimf', (-10 0 10 0)
MF3='hot':'trapmf', (0 15 30 30)

Step6: Repeat the step 4, if there is more than one input variable

Step7: Mention the output variable, its range and membership functions

Name = 'cold' Range = (-1 1)

NumMFs = 5

MF1='closeFast':'trimf', (-1 -0.6 -0.3 0)
MF2='closeSlow':'trimf', (-0.6 -0.3 0 0)

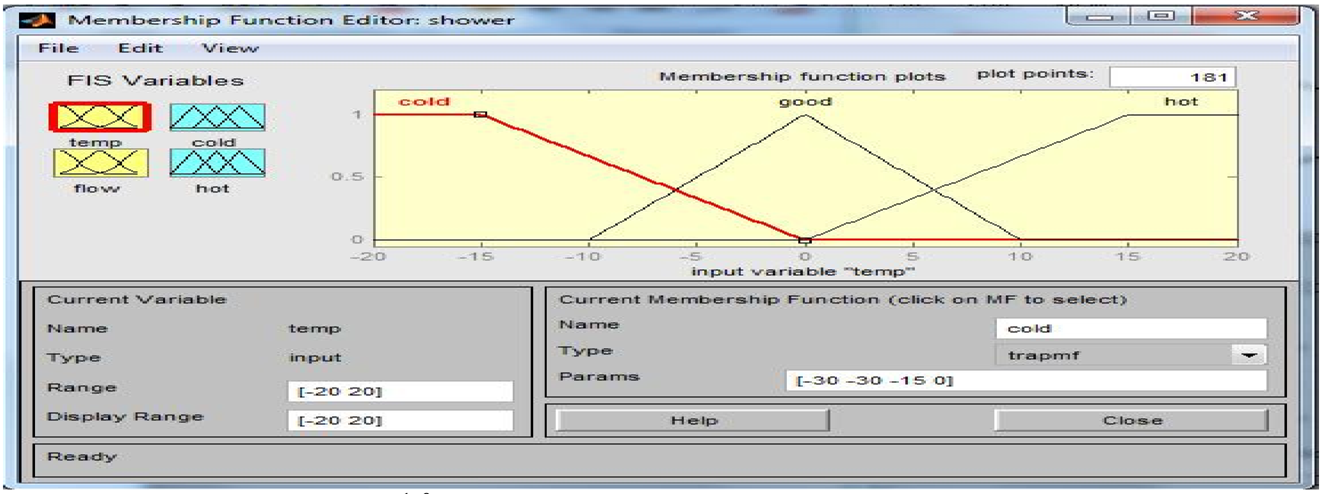
MF3='steady':'trimf', (-0.3 0 0.3 0) MF4='openSlow':'trimf', (0 0.3 0.6 0)

MF5='openFast':'trimf', (0.3 0.6 1 0)

Step8: Repeat the step 6, if there is more than one output variable

Step9: Mention the number of Rules whether in symbolic or indexed format

Step10: End



$\mu_{flow} =_{hard} = 1.0$
$\mu_{flow} =_{good} = 0.5$
$\mu_{flow} =_{soft} = 0.0$

Fig. 2. The visual representation for the fuzzy values for temperature are shown Whereas the input variable flow consists of member functions shows

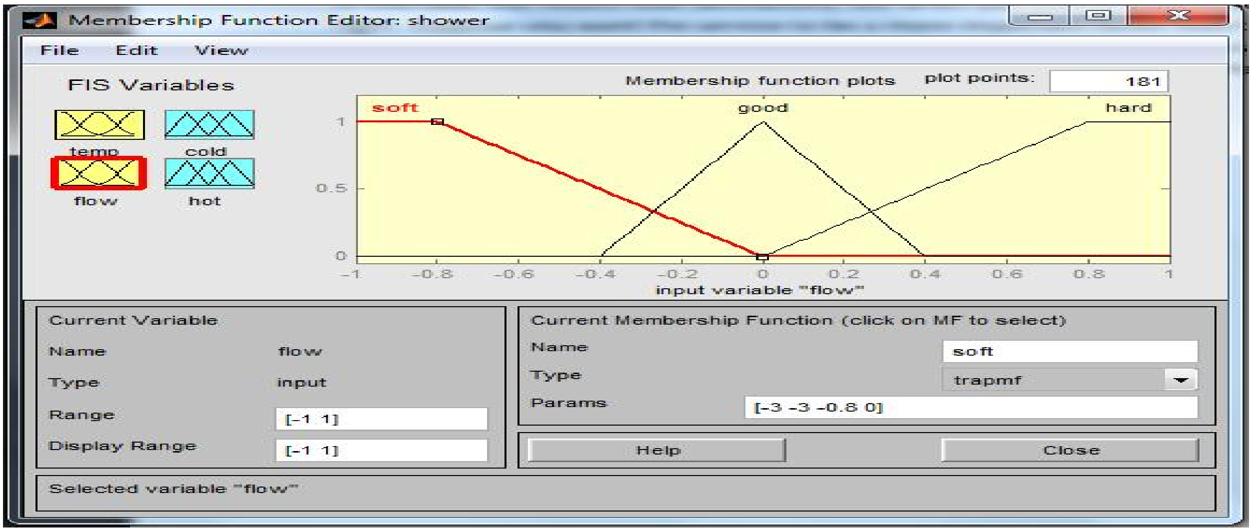


Fig. 3. The visual representation of fuzzy value 'flow' showing membership function

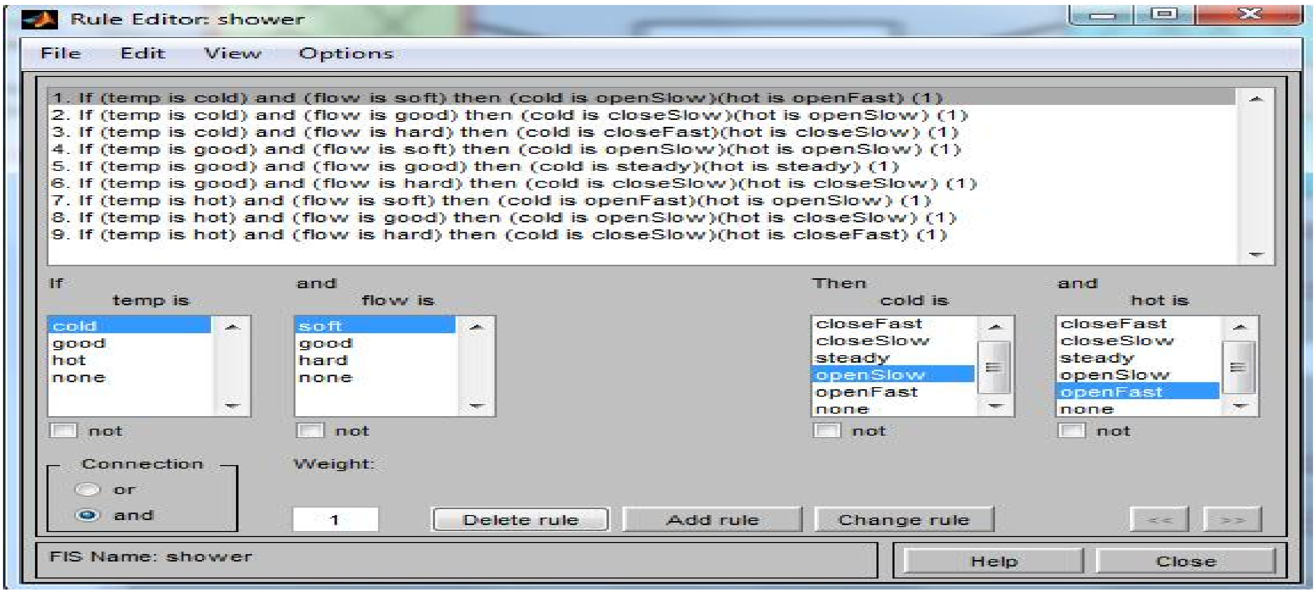


Fig. 4. Rule Evaluation Results

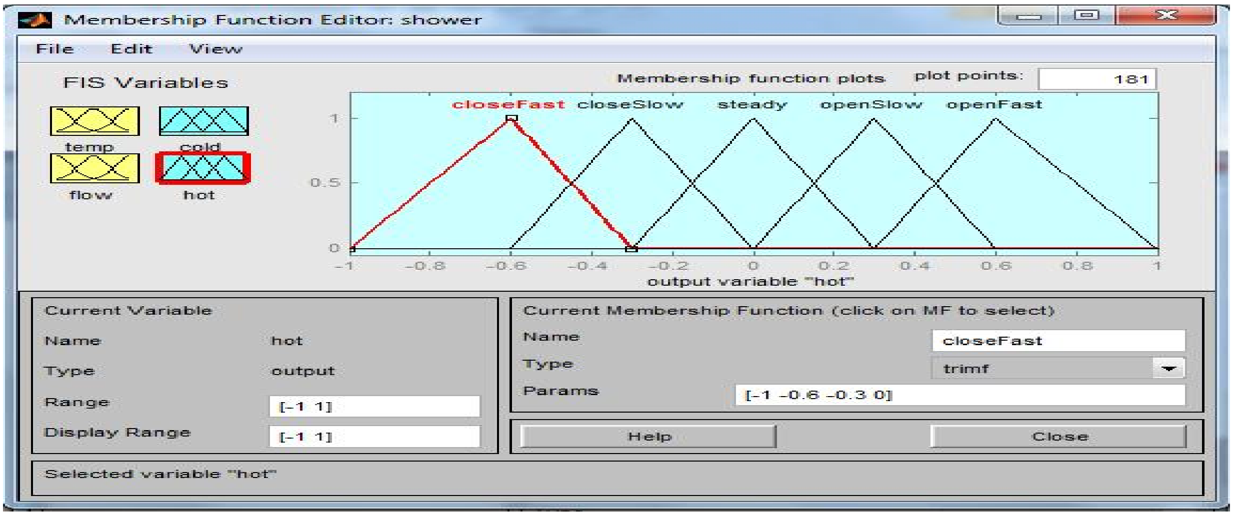


Fig. 5. Membership functions on output variable

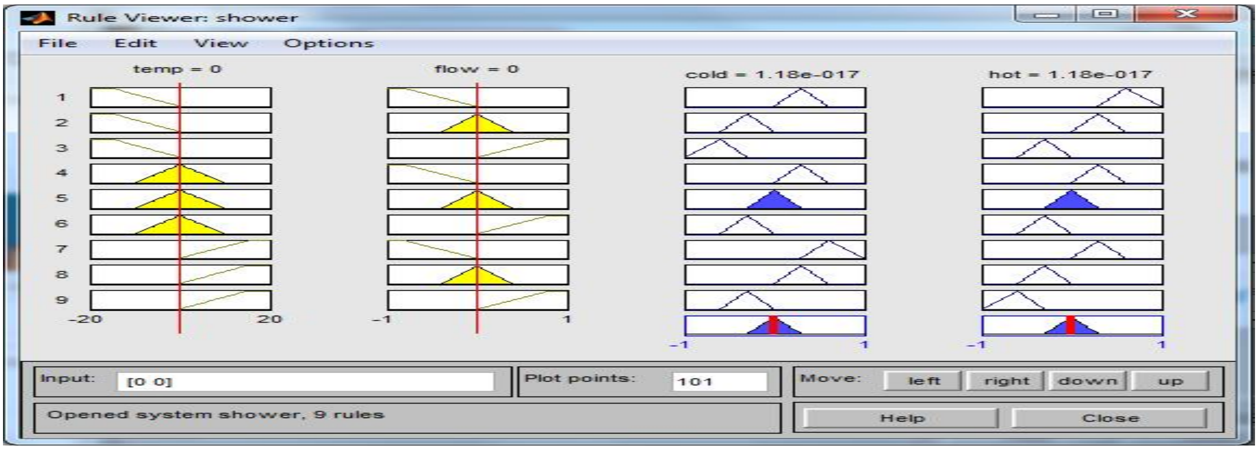


Fig. 6. Results of Rule Viewer

RESULTS

The problem is to estimate the level of risk in a (Wang and Mendel, 1992) shower problem. For sake of simplicity, this paper shows two inputs and two outputs.

Step1: fuzzification

The first step is to convert the crisp input into fuzzy one. Since we have two inputs so, there are two crisp values (Esteva and Godo, 2001) to convert where the first value is the level of temperature and the second value is the level of flow. Suppose the input temperature have membership functions mf1, mf2 and mf 3 (Fodor *et al*., 1997) which ranges from -20 to 20 so that the fuzzy values for temperature are shown in the following Figure 2.

Step 2: The Rules

Now, for the fuzzy values, use the fuzzy rules (Hajek, 1998) to arrive at the final fuzzy value. The rules are as follows:

Step 3: Defuzzification

The defuzzification method (Yager and Rybalov, 1996) can be performed in several different ways.

The most popular method is the centroid method. Centroid method calculates the center of gravity for the area under the curve

$$COG= \sum_{x=a}^{b} \mu_A(x)\, x \;/\; \sum_{x=a}^{b} \mu_A(x)$$

Where as in *Bisector* method the vertical line that divide the region in to sub regions of equal area in sometimes, but not always, coincide with the centroid line. For *mean of maximum* (Zimmermann, 1985) method assumes a plateau at the maximum value of the final function take the mean of the value its spans where as in the smallest value of maximum and largest value of maximum, the plateau at the maximum value of the final function take the smallest or largest of the value its spans.

Conclusion

Fuzzy logic is a capable instrument that is swarming each field and marking effective usage. FL (Whaley, 1979) was imagined as a superior technique for sorting and taking care of information however has ended up being a great decision for some control framework applications. It utilizes an imprecise yet extremely expressive dialect to manage information more like a human operator. FL does not oblige exact inputs, is innately powerful, and can handle any sensible number of inputs yet framework multifaceted nature increments quickly with more inputs and outputs. Basic, dialect IF X AND Y THEN Z rules are utilized to depict the desired framework reaction regarding linguistic variables rather than numerical equations (Bellman and Zadeh, 1970). Fuzzy systems are showing great guarantee in purchaser items, mechanical and business frameworks, and decision support systems. Fl (Heshmaty and and Kandel, 1985) gives a totally distinctive, strange approach to approach a control issue. This strategy concentrates on what the framework ought to do as opposed to attempting to see how it functions. One can focus on tackling the issue instead of attempting to display the framework numerically, if that is even conceivable. This perpetually prompts faster, less expensive arrangements. Once comprehended, this innovation is not hard to apply and the outcomes are normally very surprising and satisfying.

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