

Fuzzy Logic

AUTOMIZATION OF UMPIRING IN CRICKET USING FUZZY LOGIC

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ABSTRACT

Fuzzy logic has been introduced to deal with vague, imprecise and uncertain problems. A fuzzy logic controller can be regarded as an expert system that is able to process qualitative variables and to infer crisp values out of uncertainty. Hence, fuzzy logic can find applications in many aspects of real life, where there is lack of information, there is uncertainty. A good example of such an application is in AUTOMIZATION OF UMPIRING IN CRICKET

Cricket now- a -days has gone beyond the scope of a ‘game’ to be a inherent part of our senses. While millions of money is invested in this sport there exist still some discrepancies that hit heavily on the reverence to the game. Humans are always prone to errors, which hold well even with the umpires. Thus automization of the decisions will help to improve the essence of the game and ensure an even more cheerful and judicious entertainment. This paper puts forward a proposal, which aims at achieving the following objectives

- ❖ The main objectives we propose to solve are:
 - Unravel the contradiction between a boundary and a six.
 - Identify an LBW.
 - Identify a catch.
- ❖ The tool we have used is “Fuzzy Logic” as it is a good decision maker.
- ❖ Neural networks can be trained using real time data which makes it highly efficient in operation.

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INTRODUCTION

FUZZY LOGIC

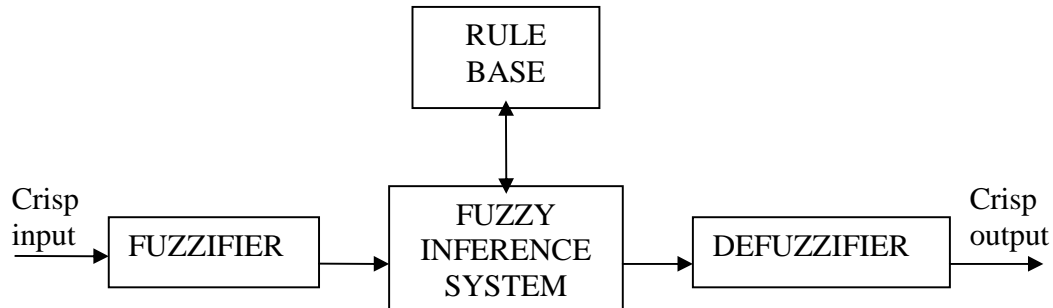
Fuzzy logic was introduced by Prof. Lofti Zadeh in 1965 as a mathematical way to represent uncertainty in everyday life. It can provide the means to represent vague and fuzzy information, manipulate it, and to draw inferences from it. In ordinary mathematics, information is of a crisp kind. It belongs to a set or it does not. The choice of a yes-or-no answer is possible and usually applied, but information could be lost in such a choice, as the degree of belonging is not taken into consideration. A fuzzy model is the idea of a fuzzy set. A fuzzy set differs from conventional (crisp) sets in its semi-permeable boundary membrane. Instead of a characteristic function that has 2 states, inclusion (1) or exclusion (2), the fuzzy set has a function that admits a degree of membership in the set from complete exclusion (0) to absolute inclusion (1). The value zero is used to symbolize complete non-membership, the value 1 is used to symbolize complete membership, and values in between are used to symbolize intermediate degrees of membership. Membership in a fuzzy subset should not be on a 0 or 1 basis, but rather on a 0 to 1 scale; that is the membership should be an element of the interval $[0,1]$. A fuzzy concept is a linguistic variable used to define a fuzzy subset, as CLOSE or FAR for a range of obstacle. A Fuzzy set comes as a generalization of conventional set theory. It is a superset of conventional (crisp) logic that has been extended to handle the concept of partial truth (truth values between “completely true” and “completely false”); allowing intermediate values between crisp values.

COMPONENTS OF FUZZY LOGIC DECISION-MAKING SYSTEM

The four principal components of the fuzzy decision-making systems are:

1. The fuzzifier determines input and output variables and maps them into linguistic variables that are to be displayed on a universe of discourse.

2. The rule base: is a part of expert systems that contains the domain knowledge. Membership functions and control rules are decided by the experts at this point, based on their knowledge of the system.



A Fuzzy Decision Making System

3. The fuzzy inference system: treats a fuzzy set as a fuzzy proposition. One fuzzy proposition can imply another, and two or more fuzzy propositions can be associated by a Boolean connectivity relation to infer a final fuzzy proposition.

4. The defuzzifier converts the fuzzy output into a crisp (non-fuzzy) value.

WHY USE “FUZZY LOGIC” AS A TOOL?

Fuzzy Logic methodology, a branch of Artificial Intelligence is basically characterized by three traits.

- ❖ First, it does not consider whether something is true or false, but rather how true the statement is.
- ❖ Second, because it is similar to human reasoning, its implementation tends to be based on natural language.
- ❖ The third trait is that it is flexible and can model a complex, non-linear system by using imprecise information.

The mode that has just been described provides an immediate output which makes the fuzzy as the choicest tool for our problem.

FUZZIFICATION

- ❖ A membership function acts on input variables usually from sensor data, in what is known as a fuzzifier.
- ❖ The fuzzifier output is referred to as a fuzzy-data value, which is the input to the rule evaluator, which compares the fuzzy-data value to the value established for each rule.
- ❖ If one rule seems to be dominant explanation for the fuzzy-data value it is considered to have 'won'.
- ❖ This news can be de-fuzzified for our real values.

FIELD SETUP

- ❖ We install cameras at appropriate places, which are capable of providing the fuzzy system with the input values angle, height and distance. These data are then manipulated to determine the outcome of the delivery of a ball.
- ❖ The cameras may be installed at the top of the stadium to provide a panoramic view, which eases the task of measuring the height.
- ❖ The cameras may also be installed around the ground to measure other parameters like angle.
- ❖ All the cameras will always be tracking the ball, so that we have a lot of angles to look at the ball.

PARAMETERS INVOLVED

Three input parameters are involved viz height ,distance and angle.

❖ **Height:**

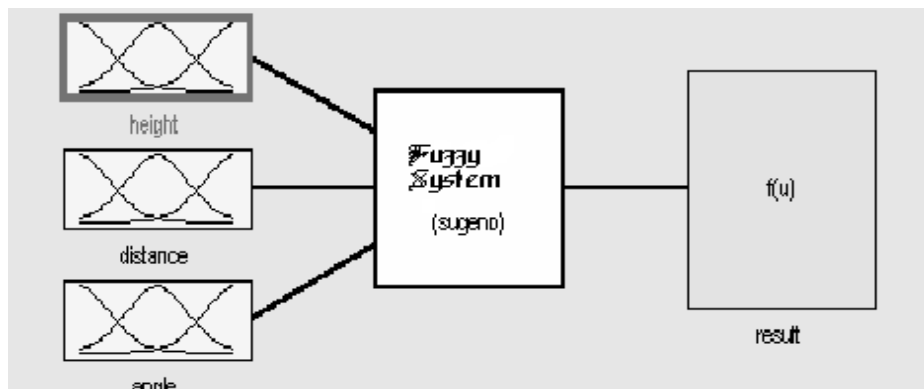
- This parameter is used to distinguish a boundary from a six. Also it is used to identify a catch.

❖ **Distance :**

- This parameter is used to determine if the ball has crossed the boundary line.

❖ **Angle:**

- This parameter is used to identify an LBW.

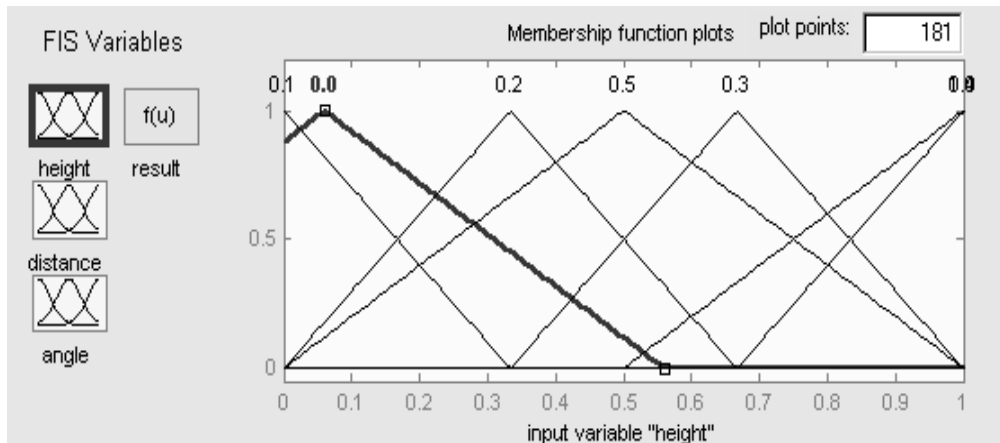


BLOCK DIAGRAM OF FUZZY SYSTEM

MEMBERSHIP FUNCTIONS

Each input has some membership functions whose value ranges between 0 and 1.

E.g.: Height has 7 membership functions 0 , 0.1 , 0.2 , 0.3 , 0.4 , 0.5 and 1.



MEMBERSHIP FUNCTION GRAPH

SOFTWARE DEVELOPED FOR THE SYSTEM

This software is developed using MATLAB.

[Input1]

Name='height'

Range=[0 1]

NumMFs=7

MF1='0.0': 'trimf', [-0.439 0.0608 0.561]

MF2='0.5': 'trimf', [0 0.5 1]

MF3='1.0': 'trimf', [0.5 1 1.5]

MF4='0.1': 'trimf', [-0.3333 0 0.3333]

MF5='0.2': 'trimf', [0 0.3333 0.6667]

MF6='0.3': 'trimf', [0.3333 0.6667 1]

MF7='0.4': 'trimf', [0.6667 1 1.333]

[Input2]

Name='distance'

Range=[0 1]

NumMFs=22

MF1='0.0': 'trimf', [-0.194 -0.0688 0.0562]

MF2='0.05': 'trimf', [-0.201 -0.076 0.0489]

MF3='0.1': 'trimf', [-0.417 -0.292 -0.168]

MF4='0.15': 'trimf', [-0.189 -0.0641 0.0612]

MF5='0.2': 'trimf', [-0.194 -0.0688 0.056]

MF6='0.25': 'trimf', [-0.214 -0.0893 0.0357]

MF7='0.3': 'trimf', [-0.243 -0.118 0.00718]

MF8='0.35': 'trimf', [-0.234 -0.109 0.0159]

MF9='0.4': 'trimf', [-0.242 -0.116 0.00775]

MF10='0.45': 'trimf', [-0.125 0 0.125]

MF11='0.5': 'trimf', [0 0.125 0.25]

MF12='0.55': 'trimf', [0.122 0.247 0.372]

MF13='0.6': 'trimf', [-0.261 -0.136 -0.0106]

MF14='0.65': 'trimf', [-0.109 0.0159 0.141]

MF15='0.7': 'trimf', [0.0132 0.138 0.263]

MF16='0.75': 'trimf', [-0.0813 0.0437 0.169]

MF17='0.8': 'trimf', [-0.321 -0.196 -0.0714]

MF18='0.85': 'trimf', [-0.0456 0.0794 0.204]

MF19='0.9': 'trimf', [-0.497 0.00265 0.503]

MF20='0.95': 'trimf', [-0.312 0.188 0.688]

MF21='1.0': 'trimf', [0.5 1 1.5]

MF22='0.74': 'trimf', [0 0.5 1]

[Input3]

Name='angle'

Range=[0 1]

NumMFs=4

MF1='0.0': 'trimf', [-0.4 0 0.4]

MF2='0.25': 'trimf', [0.1 0.5 0.9]

MF3='0.5': 'trimf', [0.6 1 1.4]

MF4='0.75': 'trimf', [-0.204 0.296 0.796]

[Output1]

Name='result'

Range=[0 1]

NumMFs=4

MF1='boundary': 'constant', 0.4

MF2='out': 'constant', 0.5

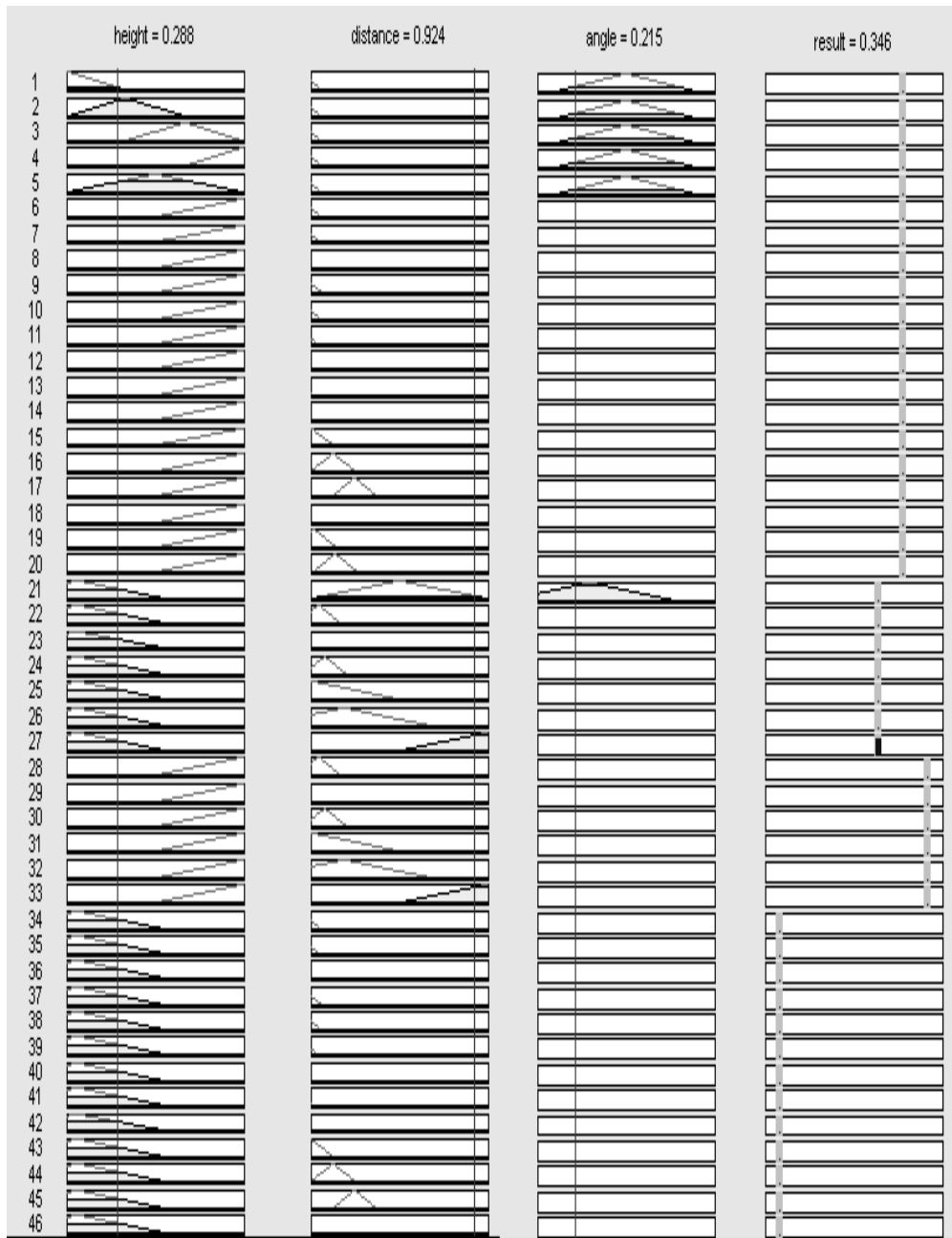
MF3='six': 'constant', 0.6

MF4='tickington': 'constant', 0

RULE VIEWER

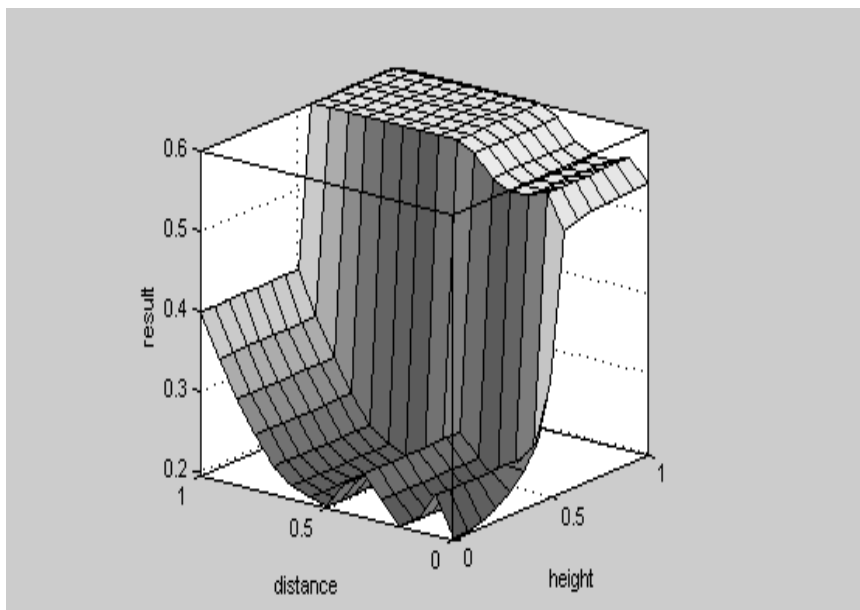
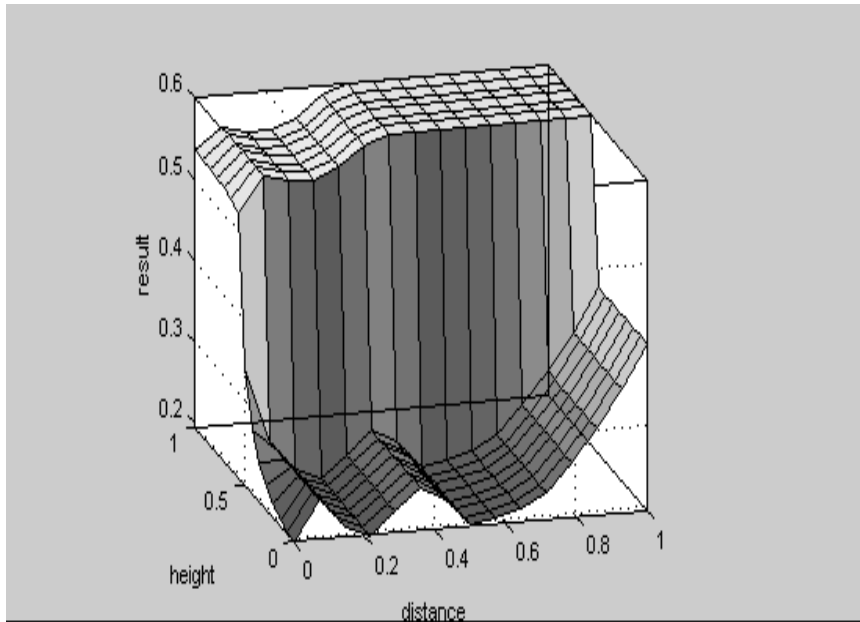
The next step is to set the rules for our system using the rule editor. The rules can be changed and results can be observed using the rule viewer as shown below.

From the figure below we observe that when the height is 0.288 and the distance is 0.924 then the result is a four!!



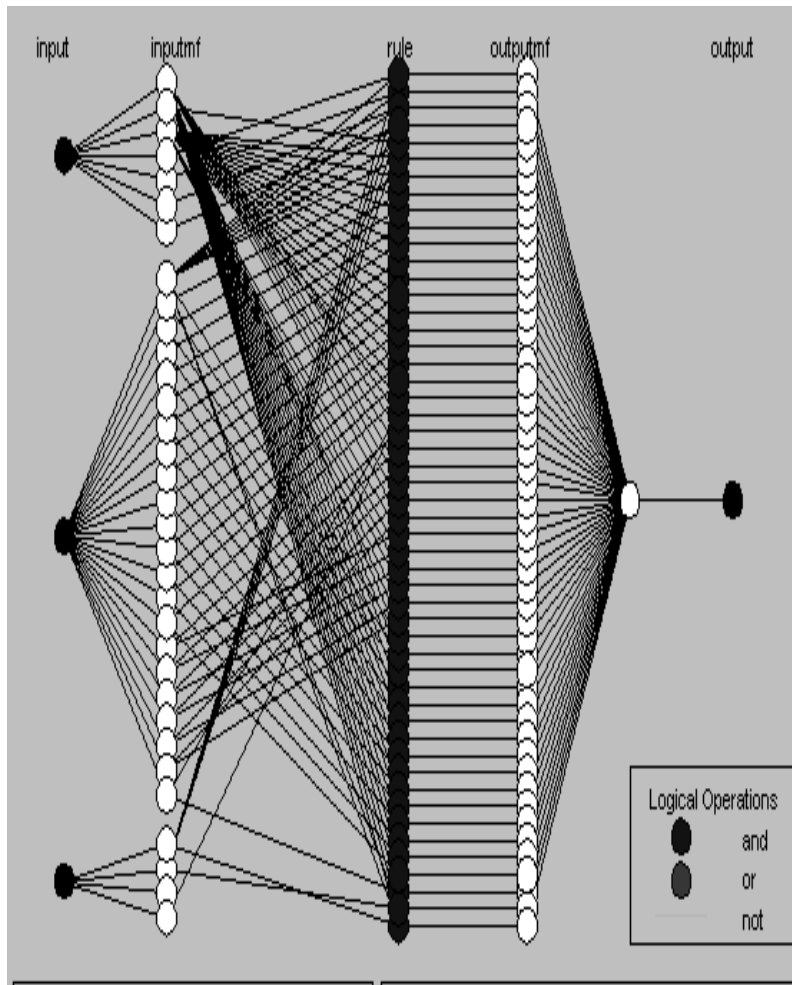
The blue mark indicates a boundary for the given condition.

MODEL OUTPUT:



The output values for the complete range of all input values are as shown by these graphs.

ANFIS GRAPH:



The graph shown above is the ANFIS graph which shows the flow of decisions as dictated by the input values and results in one of the possible outputs.

THE END (TO BEGIN WITH A REVOLUTION)

This paper deals with the real-time & fuzzy approach in automization of umpiring in cricket. Thus this system can be used to weed out inaccuracies and unprofessional conduct of umpiring of one of the world's craziest game. This proposal can be extended to include all the other rules which we have avoided for the sake of clarity.

Reference:

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