

An Application of Fuzzy Set Theory in a Volleyball Game

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Abstract

Now a day's players' performance evaluation is a critical issue. The parameters used for this purpose are vague and imprecise. The development of fuzzy set theory by Lotfi A. Zadeh in 1965 solves the problems tainted with vague, imprecise and incomplete data and provides better and accurate results. In this paper, an approach has been given to evaluate player's performance in a volleyball game based on fuzzy set theory.

Keywords: Fuzzy set theory, Performance, Players, volleyball.

1. INTRODUCTON:

This century is the time of innovation. So many researcher are try to developed many theory and justified with their own logic. Which change the way of thinking of a general people also. One of the such changes in science and mathematics in this century is the concepts of fuzzy set theory. This concepts was first develops by Prof. Lofti Zadeh, U.C. Berkeley in 1965 [1]. The basic logic behind the concepts is that every element in the set has some membership grade which is given by some function associated with that element called membership function.

There is an enough amount of scientific evidence on the benefits of sport and physical activity as part of a healthy lifestyle. It is good for mind, body, and spirit. Sometimes is important to evaluate players' performance. For a good health people often go through exercise or play game. Again some people play for entertainment or some are professionally. For professional player they must maintain their performances as performance of players directly affects their ranking internationally and also players' performance plays important role in a game which can achieve the team to win. But,

players' performance evaluation is a critical issue.

Sometimes it is important to sought experts opinion. Experts or some knowledge engineers tell about their ability after observing their game. They will comment on a particular player is good or bad. In case of any game there are lots of vague word/concept may arise. In such situation the concepts of fuzzy set occur. Here we give a concept of fuzzy based player grade point system. Application of fuzzy set in different field have been seen in [6, 7,...,13].

In this paper we proposed a theory based on expert view and give each player a grade point which can easily tell a general person a particular player is good or bad.

2. SOME DEFINITION

2.1 Characteristic function : Let A be any set then a function χ_A called Characteristic function which can take only two value either 1 when x belong to A or 0 when x not belong to A. i.e.

$$\begin{aligned} X_A(x) &= 1 \text{ if } x \text{ in } A \\ &= 0 \text{ if } x \text{ not in } A \text{ [4]} \end{aligned}$$

2.2 Fuzzy set: Let X be a universal set. Then fuzzy subset A of X is define by its membership function

$$\mu_A : X \rightarrow [0,1]$$

Which assign a real number $\mu_A(x)$ in the interval [0,1], to each element $x \in X$, where the value of each $\mu_A(x)$ at x shows the grade of membership of x in A. [3]

3. HOW TO CONSTRUCTS A MEMBERSHIP FUNCTION:

The following is a scenario within which the construction of fuzzy set takes place. The scenario involves a specific knowledge domain of interest, one or more experts in this domain and a knowledge engineer. The role of the knowledge engineer is to elicit knowledge from the expert who are assumed to posses it and to express the knowledge in some operation form of a require type. In our case the knowledge is supposed to express in terms of proposition involving linguistic variables.

Knowledge can be elicited only through interaction of the knowledge engineer with the experts. It should be done in two stage, are

- (1) The knowledge engineer attempts to elicit knowledge in terms of proposition expressed in natural language.
- (2) He or she attempts to determine the meaning of each linguistic term employed in these propositions.

It is during the second stage of knowledge acquisition that function representing fuzzy set and operation of fuzzy set are constructed [2].

4. METHODOLOGY:

After observing any game will anyone can tell that a particular player is a good player or bad player ? Obviously not, because how or for which performance or ability that can make a player good or bad that is a big question in any one’s mind. But by using fuzzy set theory this kind problem cab be remove easily. An approach has been devised here.

Let us suppose G is any game (without loss of generality let us to take a group event). Now first of all we may collect all the required knowledge about G and observing carefully one by one all the situation that may involved in that particular game. After that we may summarize a brief table for the game G for n players and mention all the possible case.

Secondly we have to choose some well known expert A_i ($i = 1,2,3,\dots,n$) and elicited knowledge through the interaction for that particular game. But in that interaction lot of linguistic term may arise. Now we attempt to determine the meaning of each linguistic term which is involved for the game.

Now we have to ask them how or using which linguistic term an expert can take a particular player take in good category.

Let us suppose there are A_i ($i = 1,2,3,\dots,n$) well know experts involved in that game and $x_1,x_2,x_3,x_4,\dots,x_n$ are the players for which we may summaries a table.

By Expert A_1 : X is GOOD PLAYER using L_1 linguistic variable.

By Expert A_2 : X is GOOD PLAYER using L_2 linguistic variable.

By Expert A_3 : X is GOOD PLAYER using L_3 linguistic variable.

.....

By Expert A_n : X is GOOD PLAYER using L_n linguistic variable.

Where,

- (1) $X_i \in A_i(L_i)$ means that the expert A_i called X_i is good by using L_i linguistic term.
- (2) $A_i(L_i)$ the expert A_i take L_i linguistic term to make his perception.

Now, we can take $X_i = 1$, when X_i belong to $A_i(L_i)$
 $= 0$, when X_i not belong to $A_i(L_i)$

Now the grade point of X_i can be evaluated by the given formula

$$\begin{aligned} \text{Gr pt } (X_i) &= \sum_{i=0}^n (X_i \in A_i(L_i)) / n \\ &= \alpha, \quad \text{where } 0 \leq \alpha \leq 1 \end{aligned}$$

In this way we may give a particular player to a specific grade point. Let us have six players with grade point as given below....

$$\begin{aligned} X_1 &= 0.2 & X_4 &= 0.65 \\ X_2 &= 0.4 & X_5 &= 0.55 \\ X_3 &= 0.7 & X_6 &= 0.85 \end{aligned}$$

From the table it is clear that X_3, X_4, X_6 are taken to be good players. But it is very easy if we pair-wise compare. And also easy to say if we take triplet or n -tuple a player is good.

5. NUMERICAL EXAMPLE

Let us elaborate the above theory with an example. Let us assume in an volleyball game. In case of a volleyball game there are a lot of fuzzinesses that may occur. Such as a good Passer, good Setter, best Hitter, the momentum of the game, poor Blocker and more.

Now we may summarize a table for some players.

<i>Name of the player</i>	<i>Matches</i>	Passing	Blocking	Hitting	Serving	Individual Defense	Digging
X_1	100	1023	566	459	2400	NO	78
X_2	179	1988	560	5001	2600	240	101
X_3	178	2507	92	4300	678	320	110
X_4	08	307	65	34	54	40	NO
X_5	150	200	1011	1500	601	450	360

Now we may summarize another table for the same player for per match.

<i>Name of the player</i>	<i>Matches</i>	Passing	Blocking	Hitting	Serving	Individual Defense	Digging
X_1	100	10.23	5.66	4.59	24.00	NO	.78
X_2	179	11.106	3.12	27.93	14.52	1.34	.56
X_3	178	14.08	.51	24.15	3.80	1.79	.617
X_4	08	38.37	8.125	4.25	6.75	5	NO
X_5	150	1.33	6.74	100	4.006	3	2.4

After the interaction with the expert a Player is said to be good by which linguistic term associate with the player are given below.

<i>Expert name</i>	<i>Linguistic term</i>	<i>Set of player</i>
A	<i>Having passing per match above 11.00 (L_1)</i>	$\{ X_2, X_3 X_4 \}$
B	<i>Having blocking per match more then 6.00 (L_2)</i>	$\{ X_4, X_5 \}$
C	<i>Having individual defense more than 1.5 per match (L_3)</i>	$\{ X_3, X_4, X_5 \}$

Now we have to calculate the membership grade for each of the player

$$Gr(X_1) = \{A(L_1) + B(L_2) + C(L_3)\} / 3 = (0 + 0 + 0) / 3 = 0/3 = 0$$

$$Gr(X_3) = \{A(L_1) + B(L_2) + C(L_3)\} / 3 = (1 + 0 + 1) / 3 = 2/3 = 0.667$$

Similarly we have to calculate for the other player are $Gr(X_2) = 0.33$, $Gr(X_4) = 1$, $Gr(X_5) = 0.667$

Now, it is easy to say which a good player is. Suppose we have to select 0.5 basic membership grades. Then the set of good player are $G_1 = \{x_3, x_4, x_5\}$

CONCLUSION

In this paper, a technique has been proposed to evaluate player's performance based on fuzzy set theory in a volleyball game. The advantage of this approach is to evaluate performance a player of any game when experts' opinions are sought. Performance of players directly affects their ranking internationally and also players' performance plays important role in a game which can achieve the team to win.

This paper can help us to tell easily which players are good and select the required top playing squad to the obtain goals.

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