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A New Condition for Conflicting Bifuzzy Sets Based On Intuitionistic Evaluation

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Abstract**—**Fuzzy sets theory affirmed that the linguistic value for every contraries relation is complementary. It was stressed in the intuitionistic fuzzy sets (IFS) that the conditions for contraries relations, which are the fuzzy values, cannot be greater than one. However, complementary in two contradict phenomena are not always true. This paper proposes a new idea condition for conflicting bifuzzy sets by relaxing the condition of intuitionistic fuzzy sets. Here, we will critically forward examples using triangular fuzzy number in formulating a new condition for conflicting bifuzzy sets (CBFS). Evaluation of positive and negative in conflicting phenomena were calculated concurrently by relaxing the condition in IFS. The hypothetical illustration showed the applicability of the new condition in CBFS for solving non-complement contraries intuitionistic evaluation. This approach can be applied to any decision making where conflicting is very much exist.

Keywords**—**Conflicting bifuzzy set, conflicting degree, fuzzy sets, fuzzy numbers.

I. Introduction

THE meaning of conflict can be defined as a state of clash or discord caused by the actual resistance of needs, values and interests. A conflict can be internal (within oneself) or external (between two or more individuals). Conflict as a concept can help explain many aspects of social life, such as fight between individuals, groups, or organizations. Every matter has two sides such as negative and positive, bad and good and etc. This concept has been well accepted and authorized by Ying Yang's theories which its become one rotundity when the both side turn into complementary. Ying Yang bipolar logic has been expanding through basic Ying Yang concept. Zhang [21] said that any product can have both good and/or bad aspects. Every relation between two agents or agencies is the equilibrium of conflict and common interests even for a married couple or for two allied countries. These are among a few examples to lead a belief that there conflicts exist in bipolar. The same analogy recommends that conflict also exist in intuition, which involve positive and negative elements.

The existence of conflict gives a roomy opportunity to be assessed and analyzed. In other word, evaluation of positive and negative elements can be done concurrently. To materialize the best selection, the decision in form of 'the best positive and the best non-negative' becomes a standpoint. Kahneman [12] said that people who make a casual intuitive judgment normally know little about their judgment come about and know even less about its logical entailments. Thus, people trapped in wrong judgment mainly because they fail to detect conflict especially when giving intuitive evaluations for both positive and negative elements. The paper by [5] highlighted the conflict evaluation in decision making. The negative element which normally neglected is now being considered concurrently with the positive element in evaluation specifically in intuitionistic evaluation.

The occurrence of contraries relation such as positive and negative property will convoke a conflict. This is the reality that cannot be denied. In mathematics, every evaluation for the contraries relation is presented in numerical. Both positive and negative will be assessed numerically to present judgment. Judgment in subjective evaluation prompts to conflict evaluation. Problem in giving evaluation for conflicting is a barrier to have the fair evaluation for every contraries relation. The subjectivity of evaluation and conflicting leads for fuzzy set theory. The theory that was established by [19] seemed perfectly match with subjectivity and characterized by a membership function which assigns to each object a grade of membership ranging between zero and one.

Zadeh [19] assumed that for every non membership degree is equal to one minus membership degree and this makes the fuzzy sets compliment. In logical area, membership degree and non-membership degree can be interpreted as positive and negative. This means if the membership is correct, that's means the non membership is wrong. Obviously this explains that the contraries relation exists. Atanassov [1] proposed his idea intuitionistic fuzzy sets which also involve contraries relation. He stated that the degree of membership and non-membership must hold the condition, $0 \leq \mu_A(x) + \upsilon_A(x) \leq 1$. He also extended the intuitionistic fuzzy sets by adding the intuitionistic index which exists because of the uncertainty of knowledge. This intuitionistic index turns the intuitionistic fuzzy sets into complementary.

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At this point, we argue the condition after taking into account cases of intuitive judgment where the condition cannot be fulfilled. What will happen if the value of membership and non-membership greater than one? How do we fulfill the condition for instances in a case where $\mu_A(x) = 0.7$ represents the membership degree, and the non-membership also equal to 0.7? This predicament gives us an opportunity to re-define a solution eventually to improve the concept of intuitionistic fuzzy sets. Based on this argument we propose a new concept so called conflicting bifuzzy set (CBFS).

The concept of bifuzzy is not totally new. It was deep-rooted in fuzzy sets theory that was introduced by [19]. The theory has been continuously expanding in a theoretical part [9] and application in various fields. It was begun in 1986, when Atanassov [1] expanded the fuzzy sets into Intuitionistic Fuzzy Sets (IFS) [1]-[4]. Then, a lot of researchers were expanding paper on intuitionistic fuzzy set based on theoretical parts, [7, 10, 13, 16]. They generated similar idea based on fuzzy sets such as interval valued fuzzy sets [15], L-fuzzy sets [11], vague sets [8], Ying-yang bipolar fuzzy logic [21], interval-valued intuitionistic fuzzy sets [3] and soft sets [6]. [17] on his paper Bifuzzy Probabilistic Sets introduced the notion of bifuzzy in another terms as intuitionistic probabilistic sets those determined by the so-called essential functions telling the belonging or the non-belonging of an element to a fuzzy sets. Most recently, [20] introduced the application of CBFS in multi-criteria decision making without any attempt to rationalize the condition in IFS. Thus, the present paper tries to put forward the idea to loose off condition in IFS and pave the way to set a new condition in CBFS.

The rest of the paper is organized as follows: The next section reviews the definitions that lead to the CBFS. Section 2 explains the definition used in this paper. Section 3 proposes a new condition in CBFS and finally, the paper in concluded in Section 4.

II. Conceptual Exploration

As a quick reference, some the definitions related to the concept of CBFS are reviewed. Zadeh [19] proposed his idea on fuzzy sets which characterized sets by a membership function.

Definition 2.1: Let X be a space of points (object), with a general element of X denoted by x. Therefore, $X = \{x\}$. A fuzzy set (class) A in X is characterized by a membership (characteristic) function $f_A(x)$ which associates with each points in X a real number in the interval $[0,1]$ with the value of $f_A(x)$ at x representing the 'grade of membership' of x in A.

Atanassov [1] introduced the concept of intuitionistic fuzzy set (IFS) characterized by a membership function and a non-membership function. This idea, which is a natural generalization of a standard fuzzy set, seems to be useful in modeling many real life situations, (Przemyslaw [14]). It was derived from the capacity of humans to develop membership functions through their own natural intellect and understanding. It also involves contextual and semantic knowledge about an issue, it can also entail linguistic truth values about this knowledge. The last decades, intuitionistic fuzzy set theory has been applied to many different fields, such as decision making and, logic programming, topology and, medical diagnosis and, pattern recognition and, machine learning and market prediction, etc. The mathematical structure introduced by Anatanssov in on the basis of ortho-pairs of fuzzy sets, and called intuitionistic fuzzy sets, (Gianpiero [10]).

Definition 2.2: An intuitionistic fuzzy set (IFS) A on a universe X is defined as an object of the following form $A = \{(x, \mu_A(x), \upsilon_A(x)) \mid x \in X\}$ where the functions $\mu_A : X \to [0,1]$ and $\upsilon_A : X \to [0,1]$ define the degree of membership and the degree of non-membership of the element $x \in X$ in A, respectively, and for every $x \in X$, $0 \le \mu_A(x) + \upsilon_A(x) \le 1$. Obviously, each ordinary fuzzy set may be written as $\{(x, \mu_A(x), 1 - \upsilon_A(x)) \mid x \in X\}$.

Recently, the necessity has been stressed of taking into consideration a third parameter $\pi_A(x)$, known as the intuitionistic fuzzy index or hesitation degree, which arises due to the lack of knowledge or 'personal error' in calculating the distances between two fuzzy sets (Tamalika [18]) . In fuzzy set, non-membership value is equal to 1 – membership value or the sum of membership degree and non-membership value is equal to 1. This is logically true. But in real world, this may not be true as human being may not express the non-membership value as 1 – membership value. This is due to the presence of uncertainty or hesitation or the lack of knowledge in defining the membership function. This uncertainty is named as hesitation degree. Thus the summation of three degrees, i.e., membership, non-membership, and hesitation degree is 1. It is obvious that $0 \le \pi_A(x) \le 1$, for each $x \in X$. So, with the introduction of hesitation degree, an intuitionistic fuzzy set A in X may be represented as $A = \{(x, \mu_A(x), \upsilon_A(x), \pi_A(x)) \mid x \in X\}$, with the condition $\mu_A(x) + \upsilon_A + \pi_A(x) = 1$.

Both fuzzy sets and intuitionistic fuzzy sets logic approach to fuzzification motivated a new idea. (Abu Osman [5]) in his paper introduced the new theoretical concept so called bifuzzy sets which is extension from IFS concepts and Ying Yang theory. He defines CBFS as follows.

Definition 2.3: Let a set X be fixed. A conflicting bifuzzy set A of X is and object has the following form: $A = \{< x, \mu_A(x), \upsilon_A(x) > \mid x \in X\}$, where the functions $\mu_A : X \to [0,1]$ represents the degree of positive x with respect to A and $x \in X \to \mu_A(x) \in [0,1]$, and the functions $\upsilon_A : X \to [0,1]$ represent the degree of negative x with respect to A and $x \in X \to \upsilon_A(x) \in [0,1]$.

In Intuitionistic fuzzy sets the bridle of memberships degree and non-membership degree in the range $[0,1]$. The problem raise here, since this condition is limited are undoubtedly not for all time true and the idea of solutions is needed to past these limitations. To solve it, the bridle in the range $[0,1]$ should be taken away. Frequently, if the competence evaluation is "smooth" ($\mu_A = 0.6$), it does not mean that the "uneven" competence was always, $\mu'_A = 1 - 0.6 = 0.4$, but it could be more that 0.4. Now from this idea we can solve the problem in IFS which the condition $0 \le \mu_A(x) + \upsilon_A(x) \le 1$ should be modify or should be taken away in taking into consideration both positive and negative. We concur that there exist a conflict when this both elements positive and negative subsist together.

III. The Condition for conflicting bifuzzy sets

The proposed idea of CBFS crop up after assigning membership for two contraries relation. For example if $\mu = 0.8$ and $\upsilon = 0.4$, the condition in Definition 2.2 could not be use any longer because of the sum is 1.2. However, the Definition 2.3 offers a solution by looking at evaluation for positive and negative parts concurrently. This is only happens in the presence of two conflicting parts.

For the illustration purposes, the condition for conflicting bifuzzy is explained using Triangular Fuzzy Number (TFN). TFN is a special case of left-right fuzzy numbers and defined by a triplet.

Two TFNs are defined prior detailing the condition in the conflicting bifuzzy concept. From the Definition 2.2, the condition in IFS can be illustrated using a complementary of TFNs to fulfill the condition $\mu_A(x) + \upsilon_A(x) = 1$. A complementary does not arise in a case where this condition is not fulfilled. Let A be a fuzzy set on X . Then let $\mu_A(x)$ be a degree to which x belongs to A . Then, let $\upsilon_A(x)$ denote a fuzzy complement where can be interpreted as the degree to which x does not belong to A . Simply, the fuzzy complement can be stated as $\upsilon_A(x) = 1 - \mu_A(x)$ for all $x \in X$. Refer to Figure 3.

The condition for CBFS at a point is complementary as long as the condition is the same as IFS. However, in the existences of conflict, the condition for CBFS is no more a complementary due to $\mu_A(x) + \upsilon_A(x) > 1$. The CBFS consist two TFNs which defined as positive and negative. These are shown in Figure 4 and Figure 5. However in conflicting, the positive and negative evaluations are co-existing. The two TFNs can be illustrated together as to explain the conflicting bifuzzy set concept. The position of TFNs for CBFS is shown in Figure 6. It clearly seen that this figure is equivalent to a complimentary of TFNs in Figure 3.

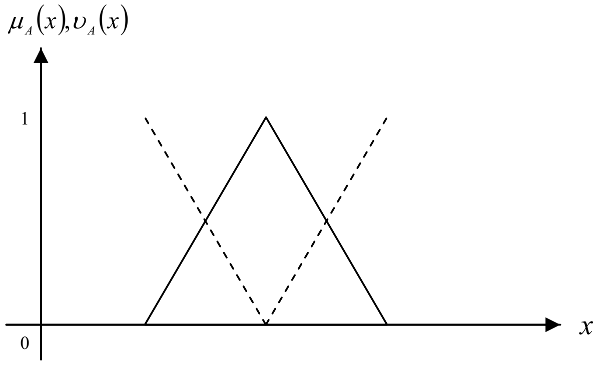

Fig. 3 TFNs complementary in IFS

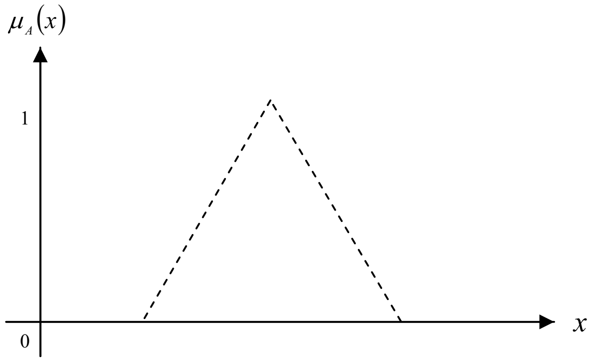

Fig. 4 Fuzzy Numbers of 'positive' evaluation

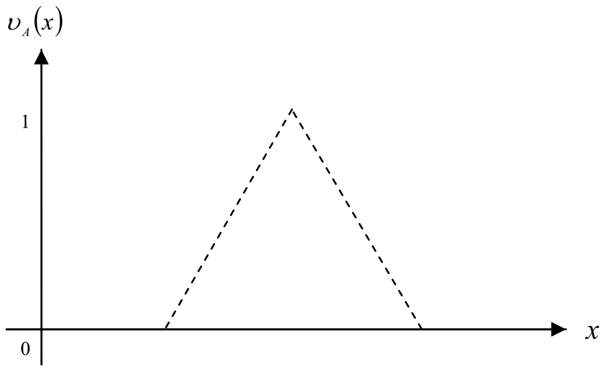

Fig. 5 Fuzzy Numbers of 'negative' evaluation

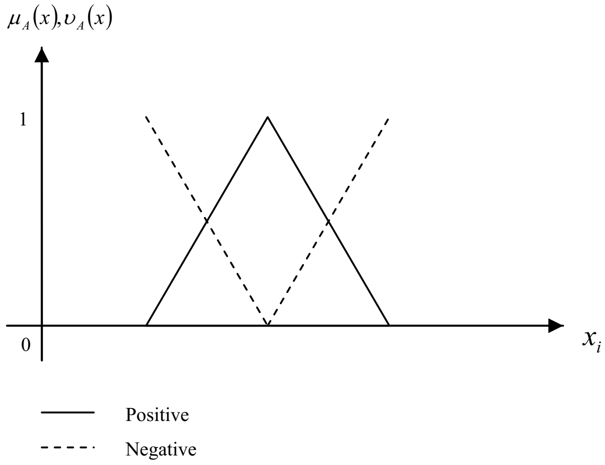

Fig. 6 Bifuzzy Number of Conflicting

We define the conflicting degree after considering Figure 6. Every point in Figure 6 is compliment to each other. Any x_i in the range of triangular shape will become complimentary. But what will happen if the symmetric line is not over lapping. At his point, x_i of positive and negative is not complement anymore. The sum of the positive and negative are greater than 1. It shows that the condition is not longer applicable. We assume this happened because the conflict exists. The conflicting membership is arbitrary depending on the shifting of TFN for both fuzzy numbers along the x-axis as long as the complementary is not met. Figure 7 and Figure 8 explain the possibility of conflicting membership degree.

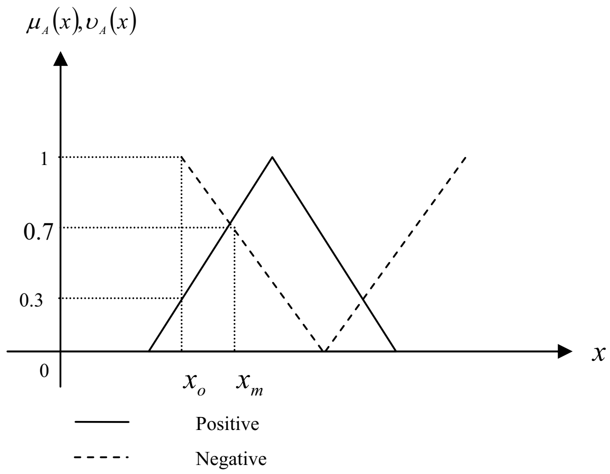

Fig. 7 the conflicting bifuzzy number

Let's have a look for two examples. From Figure 7, the $\mu_A(x_m)$ and $\upsilon_A(x_m)$ are equal to 0.7 and eventually $\mu_A(x_m)+\upsilon_A(x_m)=1.4$. Also, if $\mu_A(x_o)=1$ and $\upsilon_A(x_o)=0.3$ then $\mu_A(x_o)+\upsilon_A(x_o)=1.3$.

Obviously, the positive and negative evaluation is now greater than 1. Hence, the condition of IFS is disregarded.

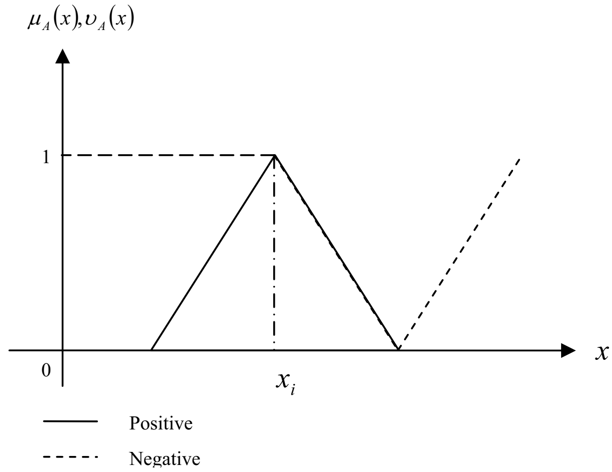

Fig. 8 Conflicting Bifuzzy Number

According to x_i in Figure 8, there is a maximum point for bifuzzy number. This happens when the negative fuzzy numbers reach the maximum point. At this point, the degree of conflicting maximum in bifuzzy reaches the maximum membership. In short, $\mu_A(x)+\upsilon_A(x)=2$. It is assumed that the conflict can be very strong when both $\mu_A(x)$ and $\upsilon_A(x)$ have the same membership degree. Sum of $\mu_A(x)$ and $\upsilon_A(x)$ for x_i in Bifuzzy Numbers may fall in the range, $0 \le \mu_A(x)+\upsilon_A(x) \le 2$.

IV. Conclusion

This paper has provided the concept of conflicting bifuzzy. Theoretical explanations and examples have convinced the existence of conflict in intuitionitics evaluation. The examples using TFN illustrated the calculation of membership function for conflicting bifuzzy. The conflicting bifuzzy has extended the condition in IFS from 0 to 2 and proposed new degree of conflicting in form of membership function. The proposed approach proved particularly well with TFN and suited to developing with other type of fuzzy numbers. This is just a piece of evidence that the conflicting bifuzzy is very much relevant in intuitionistics evaluation and need to further strengthen.

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