Fuzzy and Fuzzy-Extensions TwoFold Algebra: A Mini-review and Discussion Paper

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Abstract

The TwoFold Algebra, with its corresponding TwoFold Law or TwoFold Operation, and their derivatives of Fuzzy (and all fuzzy-extensions) Two Fold Algebras and Laws were introduced by Smarandache [1] in 2024. Although very recent, it is has spread out very fast. Practical applications and several numerical examples were presented as well.

Keywords: TwoFold Algebra; TwoFold Law; TwoFold Operation.

1 | Definition

Let's denote by fuzzy-extension theories, all types of fuzzy related theories:

Fuzzy-Extension Theories = { Fuzzy Set, Intuitionistic Fuzzy Set, Inconsistent Intuitionistic Fuzzy Set (Picture Fuzzy Set, Ternary Fuzzy Set), Pythagorean Fuzzy Set (Atanassov's Intuitionistic Fuzzy Set of second-type), q-Rung Orthopair Fuzzy Set, Spherical Fuzzy Set, Neutrosophic Set, Quadruple Neutrosophic Set, Quintuple Neutrosophic Set, n-Refined Neutrosophic Set, Plithogenic Set, and n-HyperSpherical Fuzzy Set, Regret Theory, Grey System Theory, Three-Ways Decision, etc.}.

A **TwoFold Algebra** is formed by two types of algebras:

(i) the first algebra is a _classical algebra_, with respect to the elements **x** belonging to a given set **A**;

(ii) and the second algebra is a _fuzzy_ or _fuzzy-extension algebra_ with respect to any fuzzy or fuzzy-extension components [regarding the degrees of membership/truth, and/or nonmembership/falsehood/, and/or indeterminacy, and/or other types of degree of belongingness of the elements x with respect to the set A].

This is a **hybrid structure**, since a classical algebraic operation is inter-related with a fuzzy or fuzzy-extension operation.

That's what happens in our real world.

2 | Practical Example

Two employees, John and George, work for the same company. John's degree of work quality is 70% (or 0.7) and produces 40 pieces per hour, while George's degree of work quality is 50% (or 0.5) and produces 20 pieces per hour. The manager has observed that what a worker does not do well, the other does better, or the workers complement each other. As such, he had the idea to make them work together as a team, to improve the quality and increase the quantity by 10%.

Same thing happened to the other workers in the team, so he decided to organize all to work in teams to improve the quality.

The below $\oplus$ operation:

$$\text{John}_{0.7} \oplus \text{George}_{0.5}$$

is a hybrid operation, formed by the classical union operation $\cup$ {put together John and George to do a common work},

$$\text{John} \cup \text{George} = \text{Team}$$

and a second operation, which is a fuzzy union $\vee$

$$0.7 \vee 0.5 = \max\{0.7, 0.5\} = 0.7.$$

As such, one has:

$$\text{John}_{0.7} \oplus \text{George}_{0.5} = (\text{John} \cup \text{George})_{\max\{0.7, 0.5\}}$$
$$= \text{Team}_{\max\{0.7, 0.5\}}$$

But the Team now produces 10% more total pieces, or $(40 + 20) \cdot (100\% + 10\%)$

$$\text{whence} \quad 40_{0.7} \oplus 20_{0.5} \quad = (40 + 20) \cdot (100\% + 10\%)_{\max\{0.7, 0.5\}}$$
$$= 60 \cdot (1.1)_{0.7} = 66_{0.7}$$

Therefore, the Team of John & George produces now 66 pieces of quality 70%, instead of 60 pieces with some of them of lower quality (50%).

Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the privacy-preserving nature of the data but are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there is no conflict of interest in the research.

Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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