

Paper Type: Original Article

A Schematic View of Plithogenic Cubic Sets in Pattern Recognition using Jaccard Similarity Measure

S. P. Priyadharshini ^{1,*} 

¹ Assistant Professor in Mathematics; Dr.N.G.P Institute of Technology; India; priyadharshini125@gmail.com.

Received: 12 Sep 2024

Revised: 05 Jan 2025

Accepted: 28 Jul 2025

Published: 30 Jul 2025

Abstract

Plithogenic cubic sets extend the cubic set framework into new mathematical territory that enables superior handling of decision-making and pattern recognition when dealing with uncertainty. Through Plithogenic logic researchers could develop advanced methods to represent complex patterns by supporting inconsistent and self-contradictory or combined features. This research paper explores the schematic explanation of Plithogenic cubic sets and their use in pattern recognition applications. The strong nature of pattern recognition emerge from Plithogenic logic's dimensionality flexibility when combined with a two-member structure in cubic sets while resolving imprecision and vagueness and the complexity of information aspects. Through theoretical foundations and illustrative examples the author presented their capability to employ Plithogenic cubic sets successfully in pattern recognition and classification applications. The schematic method delivers a complete grasp of Plithogenic cubic sets as an enabling instrument for pattern recognition research.

Keywords: Plithogenic Cubic Sets; Operators of Plithogenic Cubic Sets; Multi-dimensional Logic; Decision-uncertainty.

1 | Introduction

Data pattern identification and classification form a basis which pattern recognition deals with effectively. Pattern recognition serves as a central subject across multiple fields such as diagram processing and medical diagnosis and text analysis and data categorization. The actual datasets found in real-world scenarios require advanced frameworks to manage imprecise and contradictory and incomplete information because of their complex nature [1-19].

Plithogenic set which was introduced by Smarandache plays a vital role in problems dealing with many number of attributes(data sets). It is the generalization of fuzzy, intuitionistic fuzzy and neutrosophic sets. The applications of Plithogenic sets includes decision making [6], supply chain[4], management[17], multivariate data analysis [9], entropy measures [16], cognitive maps [7], supplier selection [5].

The emerging concept of Plithogenic hypersoft sets comes into the picture with the wide range of applications includes modelling a distance and similarity measures, AI based decision making [1]. Also under fuzzy neutrosophic environment[2], dual dominant attributes[8].

Plithogenic cubic sets introduced by Priyadharshini et al. [11] provide a significant improvement to traditional methodologies including fuzzy and intuitionistic fuzzy as well as neutrosophic sets. Plithogenic cubic sets



Corresponding Author: priyadharshini125@gmail.com



<https://doi.org/10.61356/j.plc.2025.4567>



Licensee **Plithogenic Logic and Computation**. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0>).

provide unique modeling abilities because they use all four compatibility values--membership and non-membership and indeterminacy and contradiction--to describe elements making them optimal for complex system modeling. Plithogenic cubic sets paved the way to establish some of the core concepts like P and R order of Plithogenic cubic sets[12], applications of lithogenic neutrosophic[13] and refined Plithogenic neutrosophic sets[10].

Plithogenic cubic sets outpace standard mathematical sets by producing multi-dimensional representations which allow attributes to express diverse levels of truth alongside falsity and uncertainty. The ability to generalize this concept has delivered helpful results when identifying patterns in scenarios where information remains uncertain or conflicting.

Through plithogenic cubic set pattern recognition our main outcome shows how to measure the similarity of numeric datasets. Jaccard measurement adapted well to evaluate plithogenic cubic sets given their distinct set designs. Through its use of overlapping and uncertain data the Jaccard method effectively finds relationship connections between patterns and groups.

This study created an adapted model to examine how plithogenic cubic sets work with pattern recognition and determined ways to handle contradictory factors with various attributes through Jaccard measurement analysis. Our research explored how this approach shows better results in real world scenarios with multiple patterns even under data uncertainty.

Our contributions include

- Defining a mathematical operators(Union, intersection) for plithogenic cubic sets.
- Developing Jaccard similarity measures to plithogenic cubic environments.
- Demonstrating the application of the proposed framework in pattern recognition problems.

2 | Preliminaries

Definition 2.1 [10] Plithogenic set (PS) is a generalization of a crisp set, a fuzzy set (FS), an intuitionistic fuzzy set (IFS) and a neutrosophic set (NS), while these four categories are represented by a single attribute value (appurtenance): single value (belonging)-for a crisp set and a FS, two values (belonging, non-belonging)-for an IFS, or triple values (belonging, non-belonging and indeterminacy) for NS.

In general, PS is a set whose members are determined by a set of elements with four or more values of attributes.

Definition 2.2 [10] Let Z be the universal set. A non-empty set $B = \{\beta_1, \beta_2, \dots, \beta_s\}, s \geq 1$ of uni-dimensional parameters and $\beta \in B$ attributes is known as the attribute value continuum of the plithogenic set. A given value whose range of all possible values (or states) is the non-empty set U , is any finite discrete set $U = \{u_1, u_2, \dots, u_s\}, 1 \leq s < \infty$, or infinitely countable set $U = \{u_1, u_2, \dots, u_\infty\}$, or infinitely uncountable (continuum) set $U =]x, y[, x < y$, where $]...[$ where U can be any open, quasi-open or closed interval from the set of real numbers of another general set.

Definition 2.3 [4] Let $\Lambda = \langle A, \lambda \rangle$ be a cubic set in a non-empty set X . Then the evaluative set of $\Lambda = \langle A, \lambda \rangle$ is defined to be a structure $\Xi_\Lambda = \{(x, E_\Lambda(x)) | x \in X\}$ where $E_\Lambda(x) = \langle l(E_\Lambda(x)), r(E_\Lambda(x)) \rangle$ with $l(E_\Lambda(x)) = \lambda(x) - A(x)^-$ and $r(E_\Lambda(x)) = A(x)^+ - \lambda(x)$ which are called the left evaluative point and the

right evaluative point respectively of $\Lambda = \langle A, \lambda \rangle$ at $x \in X$. We say that $E_\Lambda(x)$ is the evaluative point of $\Lambda = \langle A, \lambda \rangle$ at $x \in X$.

Definition 2.4 [4] Let $\Lambda = \langle A, \lambda \rangle$ be a cubic set in X with the evaluative set $\Xi_\Lambda = \{(x, E_\Lambda(x)) | x \in X\}$. An element $a \in X$ is called a stable element of $\Lambda = \langle A, \lambda \rangle$ in X if it satisfies $l(E_\Lambda(a)) = \lambda(a) - A(a)^- \geq 0$, $r(E_\Lambda(a)) = A(a)^+ - \lambda(a) \geq 0$, otherwise we say that a is an unstable element of $\Lambda = \langle A, \lambda \rangle$ in X . The set of all stable elements of $\Lambda = \langle A, \lambda \rangle$ in X is called the stable cut of $\Lambda = \langle A, \lambda \rangle$ in X and is denoted by S_Λ . The set of all unstable elements of $\Lambda = \langle A, \lambda \rangle$ in X is called the unstable cut of $\Lambda = \langle A, \lambda \rangle$ in X and is denoted by U_Λ . We say that $\Lambda = \langle A, \lambda \rangle$ is a stable cut if $S_\Lambda = X$. Otherwise, $\Lambda = \langle A, \lambda \rangle$ is called an unstable cubic set.

Definition 2.5 [5] For a non-empty set A , the Plithogenic fuzzy cubic set (PFCS) is defined as $\Gamma = \{ \langle a, X(a), \mu(a) \rangle | a \in A \}$ in which A is an interval valued Plithogenic fuzzy set and μ is a fuzzy set in A .

Definition 2.6 [5] Let Δ be a universal set and A be a non-empty set. The structure $\Psi = \{ \langle a, Y(a), \delta(a) \rangle | a \in A \}$ is said to be Plithogenic Intuitionistic fuzzy cubic set (PIFCS) in A , where $Y = \left\{ \left(Y_{d_i}^T(a), Y_{d_i}^F(a) \right) \right\}$ is an Intuitionistic fuzzy set in A and $\delta = \{ (\delta_i^T(y), \delta_i^F(y)) \}$ is an intuitionistic fuzzy set in Y .

Definition 2.7 [5] Let Δ be a universal set and A be a non-empty set. The structure $\Omega = \{ \langle a, Z(a), \lambda(a) \rangle | a \in A \}$ is said to be Plithogenic Neutrosophic cubic set (PNCS) in A , where $Z = \left\{ \left(Z_{d_i}^T(a), Z_{d_i}^N(a), Z_{d_i}^F(a) \right) \right\}$ is an interval valued Plithogenic Neutrosophic set in A and $\lambda = \{ (\lambda_i^T(a), \lambda_i^N(a), \lambda_i^F(a)) \}$ is a neutrosophic set in A .

The pair $\Lambda = \langle Z, \lambda \rangle$ is called Plithogenic neutrosophic cubic set over Δ where Λ is a mapping given by $\Lambda: Z \rightarrow NC(\Delta)$. The set of all Plithogenic neutrosophic cubic sets over Δ will be denoted by PN^Δ .

3 | Operators of Plithogenic Cubic Sets

In this section, the focus is on defining the fundamental operators of Plithogenic Cubic Sets, specifically union and intersection, which are essential for processing and analyzing such sets in various applications.

Union of Plithogenic fuzzy Cubic sets

$$\begin{aligned} & [(m_1^-, m_1^+) \vee (n_1^-, n_1^+)] \\ &= [(m_1^- \vee n_1^-, m_1^+ \vee n_1^+)] \\ &= \left[((1 - c_0)[m_1^- \vee n_1^-] + c_0[m_1^- \wedge n_1^-]), ((1 - c_0)[m_1^+ \vee n_1^+] + c_0[m_1^+ \wedge n_1^+]) \right] \end{aligned}$$

Union of Plithogenic Intuitionistic fuzzy Cubic sets

$$[(m_1^-, m_1^+), (m_2^-, m_2^+)] \vee [(n_1^-, n_1^+), (n_2^-, n_2^+)]$$

$$\begin{aligned}
&= [(m_1^- \vee n_1^-, m_1^+ \vee n_1^+), \\
&\quad (m_2^- \wedge n_2^-, m_2^+ \wedge n_2^+)] \\
&= \left[((1-c_0)[m_1^- \vee n_1^-] + c_0[m_1^- \wedge n_1^-]), ((1-c_0)[m_1^+ \vee n_1^+] + c_0[m_1^+ \wedge n_1^+]) \right] \\
&= \left[((1-c_0)[m_2^- \wedge n_2^-] + c_0[m_2^- \vee n_2^-]), ((1-c_0)[m_2^+ \wedge n_2^+] + c_0[m_2^+ \vee n_2^+]) \right]
\end{aligned}$$

Union of Plithogenic neutrosophic Cubic sets

$$\begin{aligned}
&[(m_1^- \vee n_1^-, m_1^+ \vee n_1^+), \left(\frac{1}{2}(m_2^- \wedge n_2^- + m_2^- \vee n_2^-), \frac{1}{2}(m_2^+ \wedge n_2^+ + m_2^+ \vee n_2^+) \right), \\
&\quad (m_3^- \wedge n_3^-, m_3^+ \wedge n_3^+)] \\
&= \left[((1-c_0)[m_1^- \vee n_1^-] + c_0[m_1^- \wedge n_1^-]), ((1-c_0)[m_1^+ \vee n_1^+] + c_0[m_1^+ \wedge n_1^+]) \right] \\
&= \left[\left[\frac{1}{2}((1-c_0)[m_2^- \wedge n_2^-] + c_0[m_2^- \vee n_2^-]) + (1-c_0)[m_2^- \vee n_2^-] + c_0[m_2^- \wedge n_2^-] \right] \right. \\
&\quad \left. \left[\frac{1}{2}((1-c_0)[m_2^+ \wedge n_2^+] + c_0[m_2^+ \vee n_2^+]) + (1-c_0)[m_2^+ \vee n_2^+] + c_0[m_2^+ \wedge n_2^+] \right] \right] \\
&= \left[((1-c_0)[m_3^- \wedge n_3^-] + c_0[m_3^- \vee n_3^-]), ((1-c_0)[m_3^+ \wedge n_3^+] + c_0[m_3^+ \vee n_3^+]) \right]
\end{aligned}$$

Intersection of Plithogenic fuzzy Cubic sets

$$\begin{aligned}
&[(m_1^-, m_1^+)] \wedge [(n_1^-, n_1^+)] \\
&= [(m_1^- \wedge n_1^-, m_1^+ \wedge n_1^+)] \\
&= \left[((1-c_0)[m_1^- \wedge n_1^-] + c_0[m_1^- \vee n_1^-]), ((1-c_0)[m_1^+ \wedge n_1^+] + c_0[m_1^+ \vee n_1^+]) \right]
\end{aligned}$$

Intersection of Plithogenic Intuitionistic fuzzy Cubic sets

$$\begin{aligned}
&[(m_1^-, m_1^+), (m_2^-, m_2^+)] \wedge [(n_1^-, n_1^+), (n_2^-, n_2^+)] \\
&= [(m_1^- \wedge n_1^-, m_1^+ \wedge n_1^+), \\
&\quad (m_3^- \vee n_3^-, m_3^+ \vee n_3^+)] \\
&= \left[((1-c_0)[m_1^- \wedge n_1^-] + c_0[m_1^- \vee n_1^-]), ((1-c_0)[m_1^+ \wedge n_1^+] + c_0[m_1^+ \vee n_1^+]) \right] \\
&= \left[((1-c_0)[m_3^- \vee n_3^-] + c_0[m_3^- \wedge n_3^-]), ((1-c_0)[m_3^+ \vee n_3^+] + c_0[m_3^+ \wedge n_3^+]) \right]
\end{aligned}$$

Intersection of Plithogenic neutrosophic Cubic sets

$$\begin{aligned}
&[(m_1^-, m_1^+), (m_2^-, m_2^+), (m_3^-, m_3^+)] \wedge [(n_1^-, n_1^+), (n_2^-, n_2^+), (n_3^-, n_3^+)] \\
&= \left[(m_1^- \wedge n_1^-, m_1^+ \wedge n_1^+), \left(\frac{1}{2}(m_2^- \vee n_2^- + m_2^- \wedge n_2^-), \frac{1}{2}(m_2^+ \vee n_2^+ + m_2^+ \wedge n_2^+) \right), \right. \\
&\quad \left. (m_3^- \vee n_3^-, m_3^+ \vee n_3^+) \right] \\
&= \left[((1-c_0)[m_1^- \wedge n_1^-] + c_0[m_1^- \vee n_1^-]), ((1-c_0)[m_1^+ \wedge n_1^+] + c_0[m_1^+ \vee n_1^+]) \right] \\
&= \left[\left[\frac{1}{2}((1-c_0)[m_2^- \vee n_2^-] + c_0[m_2^- \wedge n_2^-]) + (1-c_0)[m_2^- \wedge n_2^-] + c_0[m_2^- \vee n_2^-] \right] \right. \\
&\quad \left[\frac{1}{2}((1-c_0)[m_2^+ \vee n_2^+] + c_0[m_2^+ \wedge n_2^+]) + (1-c_0)[m_2^+ \wedge n_2^+] + c_0[m_2^+ \vee n_2^+] \right] \right] \\
&= \left[((1-c_0)[m_3^- \vee n_3^-] + c_0[m_3^- \wedge n_3^-]), ((1-c_0)[m_3^+ \vee n_3^+] + c_0[m_3^+ \wedge n_3^+]) \right]
\end{aligned}$$

4 | Steps Involved in Applying Jaccard Similarity Measure in Plithogenic Neutrosophic Cubic Sets for Pattern Recognition

- Identify the patterns or entities to be compared and represent them as ideal plithogenic neutrosophic cubic sets.
- Represent each element in the set with degrees of membership, non-membership, indeterminacy, and contradiction values.
- Assign weights to attributes if certain features have higher importance in the recognition process.
- Define the Jaccard similarity measure to handle multiple dimensions of the plithogenic cubic set.
- Incorporate contradiction values into the similarity measure to account for variations and conflicts in data.
- Compute the intersection (commonalities) and union (total range) for membership, non-membership, and
- indeterminacy values.
- Use the computed intersection and union to calculate the Jaccard similarity index as the ratio of the sum of
- minima to the sum of maxima.
- Compare the calculated similarity values to identify similar and dissimilar patterns.
- Assign patterns to categories or clusters based on their similarity scores.
- Validate the results using additional trait values to ensure accuracy.

5 | Applications

Pattern recognition in consumer behavior involves analyzing key attributes to segment customers and tailor offerings effectively. Here's an overview of the attributes used in this process.

- Age influences preferences and purchasing decisions. Younger consumers often opt for trendy, budget-friendly products, while older demographics may prioritize quality and practicality.
- Income level determines purchasing power. Higher-income groups tend to favor premium or luxury products, whereas lower-income consumers focus on affordability and essential goods.
- Spending habits reflect how consumers allocate their resources, whether they are impulsive buyers, cautious spenders, or value-driven. This information is critical for designing promotions and pricing strategies.
- The frequency of purchases indicates how often consumers buy products or services. Regular buyers may benefit from loyalty programs, while occasional shoppers may respond better to promotional campaigns.
- Preferred Product Categories: Consumers have preferences for certain product categories, such as fashion, technology, or household items. Identifying these preferences helps businesses align their offerings with customer interests.

These attributes, when analyzed together, form distinct patterns that guide decision-making in marketing, product development, and customer engagement.

Table 1. Ideal Pattern (IP).

Measures of Contradiction	0	0.3	0.5	0.7	1
Trait Values	Age	Income Level	Spending Habits	Frequency of Purchases	Preferred Product Categories
Integral Measure function $Z(a)$	([0.2, 0.5], [0.1, 0.3], [0.4, 0.6])	([0.4, 0.8], [0.5, 0.6], [0.1, 0.2])	([0.1, 0.4], [0.3, 0.5], [0.1, 0.3])	([0.2, 0.4], [0.8,0.9], [0.4, 0.6])	([0.7, 0.8], [0.2,0.4], [0.8, 0.9])
$\lambda(a)$	([0.3,0.2, 0.1])	([0.4, 0.6, 0.7])	([0.2, 0.5, 0.6])	([0.1, 0.2, 0.3])	([0.5, 0.2, 0.9])

Table 2. Pattern 1 (P1).

Measures of Contradiction	0	0.3	0.5	0.7	1
Trait Values	Age	Income Level	Spending Habits	Frequency of Purchases	Preferred Product Categories
Integral Measure function $Z(a)$	([0.1, 0.5], [0.2, 0.3], [0.6, 0.8])	([0.6, 0.7], [0.1, 0.3], [0.4, 0.5])	([0.5, 0.7], [0.3, 0.4], [0.8, 0.9])	([0.1, 0.3], [0.4,0.5], [0.1, 0.4])	([0.2, 0.7], [0.6, 0.8], [0.2, 0.5])
$\lambda(a)$	([0.4,0.1, 0.5])	([0.1, 0.1, 0.3])	([0.1, 0.2, 0.5])	([0.2, 0.3, 0.1])	([0.2, 0.9, 0.5])

Table 3. Pattern 2 (P2).

Measures of Contradiction	0	0.3	0.5	0.7	1
Trait Values	Age	Income Level	Spending Habits	Frequency of Purchases	Preferred Product Categories
Integral Measure function $Z(a)$	([0.3, 0.4], [0.7, 0.8], [0.1, 0.5])	([0.2, 0.5], [0.6, 0.7], [0.1, 0.9])	([0.5, 0.7], [0.2, 0.4], [0.1, 0.4])	([0.1, 0.3], [0.4,0.8], [0.5, 0.7])	([0.6, 0.8], [0.3,0.4], [0.1, 0.2])
$\lambda(a)$	([0.4,0.5, 0.7])	([0.4, 0.8, 0.7])	([0.3, 0.4, 0.6])	([0.1, 0.2, 0.3])	([0.1, 0.5, 0.7])

Table 4. Pattern 3 (P3).

Measures of Contradiction	0	0.3	0.5	0.7	1
Trait Values	Age	Income Level	Spending Habits	Frequency of Purchases	Preferred Product Categories
Integral Measure function $Z(a)$	([0.4, 0.5], [0.2, 0.6], [0.1, 0.5])	([0.2, 0.3], [0.6, 0.7], [0.5, 0.6])	([0.3, 0.5], [0.8, 0.9], [0.6, 0.7])	([0.2, 0.3], [0.1,0.4], [0.6, 0.8])	([0.5, 0.6], [0.7, 0.9], [0.1, 0.4])
$\lambda(a)$	([0.5,0.8, 0.9])	([0.1, 0.2, 0.5])	([0.1, 0.3, 0.6])	([0.1, 0.5, 0.3])	([0.3, 0.2, 0.6])

Table 5. The Jaccard similarity measures for ideal pattern with pattern 1, 2 and 3 are given below.

Operators of PNCS	$IP \cup P1$	$IP \cap P1$	$IP \cup P2$	$IP \cap P2$	$IP \cup P3$	$IP \cap P3$
$Z(a)$	0.5	0.6	0.4	0.3	0.7	0.4
$\lambda(a)$	0.1	0.4	0.5	0.4	0.2	0.5
Jaccard Similarity Measure	(1.2, 4)		(0.75, 0.8)		(0.57, 2.5)	

The inference shows that Pattern 2 is more reliable than Patterns 1 and 3 when compared to the ideal pattern. This reliability is crucial for applications that demand accuracy and dependability. Overall, the analysis highlights the need to choose the most effective pattern for achieving the best results as shown in Tables 1-5.

6 | Conclusion

The integration of plithogenic cubic sets into pattern recognition represents a significant advancement in handling complex, contradictory, and multi-dimensional data. By addressing the limitations of traditional fuzzy, intuitionistic fuzzy and neutrosophic sets, Plithogenic cubic set provides a better framework for diverse applications. However, further research is necessary to address computational challenges, improve real-world applicability, and explore hybrid models for even greater versatility.

Funding

This research has no funding source.

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.

References

- [1] Ahmad M.R, Afzal U.(2022), Mathematical modeling and AI based decision making for COVID-19 suspects backed by novel distance and similarity measures on plithogenic hypersoft sets. *Artificial Intelligence in Medicine.*;132:102390. <https://doi.org/10.1016/j.artmed.2022.102390>.
- [2] Ahmad M.R, Saeed M, Afzal U, Yang MS.(2020) *A Novel MCDM Method Based on Plithogenic Hypersoft Sets under Fuzzy Neutrosophic Environment.* *Symmetry.*;12(11):1855. <https://doi.org/10.3390/sym12111855>.
- [3] Atanassov KT(2020). *Circular intuitionistic fuzzy sets.* *Journal of Intelligent & Fuzzy Systems.*;39(5):5981–5986. <https://doi.org/10.3233/JIFS-189072>.
- [4] Basset MA, Mohamed R, Zaied AH, Smarandache F. (2019), A Hybrid Plithogenic Decision-Making Approach with Quality Function Deployment for Selecting Supply Chain Sustainability Metrics. *Symmetry.*;11(7):1–21. Available from: <https://doi.org/10.3390/sym11070903>.

- [5] Basset MA, Mohamed R, Smarandache F, Elhoseny(2021). *A New Decision-Making Based on Plithogenic Set for Supplier Selection*. Computers, Materials & Continua.66(3):2751–2769.:<https://doi.org/10.32604/cmc.2021.013092>.
- [6] Gomathy S, Nagarajan D, Broumi S, Lathamaheswari M. *Plithogenic sets and their application in decision making*. 2020. https://digitalrepository.unm.edu/nss_journal/vol38/iss1/30.
- [7] Nivetha Martin and Florentin Smarandache,(2020) *Plithogenic Cognitive Maps in Decision Making*, International Journal of Neutrosophic Science 9(1) , 09-21.
- [8] Nivetha M, Smarandache F, Broumi S. (2021),*COVID-19 Decision-Making Model using Extended Plithogenic Hypersoft Sets with Dual Dominant Attributes*. Journal of International Journal of Neutrosophic Science. 13(2):75–86. <https://doi.org/10.54216/IJNS.130204>.
- [9] Prem Kumar Singh,(2020), *Plithogenic set for multi-variable data analysis*, International Journal of Neutrosophic Science 1 (2) 81-89.
- [10] Priyadharshini S.P, Irudayam N(2021), *A Novel Approach of Refined Plithogenic Neutrosophic Sets in Multi Criteria Decision Making*. International Research Journal of Modernization in Engineering Technology and Science.;3(5):735–739. <https://tinyurl.com/yc4v49ak>.
- [11] Priyadharshini S.P, Irudayam N, Smarandache F(2020),*Plithogenic Cubic Sets*. International Journal of Neutrosophic Science.,11:30–38. <https://doi.org/10.5281/zenodo.4030378>.
- [12] Priyadharshini S.P, Irudayam FN.(2021) *P and R Order of Plithogenic Neutrosophic Cubic sets*. Neutrosophic sets and systems,47,273-285.https://digitalrepository.unm.edu/nss_journal/vol47/iss1/18.
- [13] Priyadharshini S.P, Irudayam FN.(2021), *A New approach of Multi-Dimensional Single Valued Plithogenic Neutrosophic Set in Multi Criteria Decision Making*., Neutrosophic sets and systems,45,121-132. https://digitalrepository.unm.edu/nss_journal/vol45/iss1/11.
- [14] Priyadharshini S.P, Ramkumar.J,(2025) *Stable Plithogenic Cubic Sets*, Journal of fuzzy extension and Applications, 6(2),410-423.<https://doi.org/10.22105/jfea.2025.449408.1422>
- [15] Saqlain M, Riaz M, Saleem MA, Yang MS, MN J, M S. (2021)*Distance and Similarity Measures for Neutrosophic HyperSoft Set (NHSS) With Construction of NHSS-TOPSIS and Applications*. Matrix Theory for Neutrosophic Hypersoft Set and Applications in Multi attributive Multicriteria Decision-Making Problems, 1–15. <https://doi.org/10.1109/ACCESS.2021.3059712>.
- [16] Smarandache F.(2022). *Plithogeny, Plithogenic Set, Logic, Probability and Statistics: A Short Review*. Journal of Computational and Cognitive Engineering.,1(2):47–50. <https://doi.org/10.47852/bonviewJCCE2202191>.
- [17] Quack SG, Selvachandran G, Smarandache F, Vimala J, Le SH, Bui QT, (2020), *Entropy Measures for Plithogenic Sets and Applications in Multi-Attribute Decision Making*. Mathematics. ;8(6):965–965. <https://doi.org/10.3390/math8060965>.
- [18] Wang P, Lin Y, Fu M, Wang Z(2023). VIKOR Method for Plithogenic Probabilistic Linguistic MAGDM and Application to Sustainable Supply Chain Financial Risk Evaluation. International Journal of Fuzzy Systems. 25(2):780–793. <https://doi.org/10.1007/s40815-022-01401-0>.
- [19] Zhao J, Li B, Rahman AU, Saeed M(2023) An intelligent multiple-criteria decision-making approach based on sv-neutrosophic hypersoft set with possibility degree setting for investment selection. Management Decision,61(2):472–485. <https://doi.org/10.1108/MD-04-2022-0462>.

Disclaimer/Publisher’s Note: The perspectives, opinions, and data shared in all publications are the sole responsibility of the individual authors and contributors, and do not necessarily reflect the views of Sciences Force or the editorial team. Sciences Force and the editorial team disclaim any liability for potential harm to individuals or property resulting from the ideas, methods, instructions, or products referenced in the content.