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DE-NEUTROSOPHICATION TECHNIQUE OF SINGLE VALUED LINEAR HEPTAGONAL NEUTROSOPHIC NUMBER

AMALA S. RICHARD[1] AND A. RAJKUMAR

ABSTRACT. Neutrosophic theory and applications have been expanding in all directions at an astonishing rate especially after the introduction the journal entitled "Neutrosophic Sets and Systems". In this paper the evolution of neutrosophic number is defined as Single Valued Linear Heptagonal Neutrosophic Number (SVLNN) is introduced. The De-Neutrosophication method is introduced to convert neutrosophic number into a crisp number is found using Removal area method.

1. INTRODUCTION

The Theory of uncertainty plays an important role to deal with different issues relating to structure modeling in engineering domain, to do statistical calculation, in the field of social science and in any sort of real life problems relating to decision making and networking. After the invention of fuzzy set theory, researchers from several fields developed triangular, trapezoidal, pentagonal fuzzy number and its applications in various field of research. Smarandache[2] proposed the concept of neutrosophic sets, which was published in 1998, comprised of three distinct logical components: i) Truthfulness, ii) Indeterminacy, iii) Falsity. Due to the presence of hesitation component this theory gave a high impact in different kind of research domain. Further; Ye[3] formulated the concept of

[1]*corresponding author*
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simplified Neutrosophic Sets. Several researches on neutrosophic arena were published in different fields like multi criteria decision making, graph theory, optimization techniques etc. Recently (2019), Chakraborty[4] manifested the concept of pentagonal neutrosophic number and its classification component wise and applied it in solving a transportation problem in neutrosophic domain. Demonstration of pentagonal neutrosophic fuzzy number has been contributed by Avishek Chakraborty.

2. Mathematical Preliminaries

Definition 2.1. *(Fuzzy Set, [1]) A set $\bar{A}$ is denoted as $\bar{A} = \{(x, \mu_{\bar{A}}(x)) : x \in X, \mu_{\bar{A}}(X) \in [0,1]\}$ represented by $(x, \mu_{\bar{A}}(x))$, where $x \in$ the crisp set X and $\mu_{\bar{A}}(x) \in$ the interval $[0,1]$, the set $\bar{A}$ is called fuzzy set.*

Definition 2.2. *(Intuitionistic Fuzzy Set (IFS), [3]) A Set $\bar{A}$, is defined as $\bar{A} = \{\langle x; [\tau(x), \varphi(x)]\rangle\} : x \in X$, Where $\tau(x) : X \to [0,1]$ is named as the truth membership function which indicates the degree of assurance, $\varphi(x) : X \to [0,1]$ is named the falsity membership and $\tau(x), \varphi(x)$ satisfies the following relation $0 \leq \tau(x) + \varphi(x) \leq 1$.*

Definition 2.3. *(Single Valued Linear Neutrosophic Set (SVLNS), [1]) A Neutrosophic set $\overline{nA}$ is said to be a single-Valued linear Neutrosophic Set $(S_{\overline{nA}})$ if x is a single-valued independent variable, $S_{\overline{nA}} = \{x; \langle[\rho_{\overline{nA}}(x), \sigma_{\overline{nA}}(x), \omega_{nA}(x)]\rangle : x \in X\}$, where $\rho_{\overline{nA}}(x), \sigma_{\overline{nA}}(x), \omega_{nA}(x)$ denoted the concept of trueness, indeterminacy and falsity memberships function respectively.*

Definition 2.4. *(Single Valued Linear Pentagonal Neutrosophic Number (SVLPNN), [1]) A single valued linear pentagonal neutrosophic number $\bar{S}$ is defined and described as*

$$\bar{S} = \left\langle \left[\left(g^1, h^1, i^1, j^1, k^1\right); \rho\right], \left[\left(g^2, h^2, i^2, j^2, k^2\right); \sigma\right], \left[\left(g^3, h^3, i^3, j^3, k^3\right); \omega\right] \right\rangle,$$

where $\rho, \sigma, \omega \in [0,1]$. The truth membership function $(\theta_s) : R \to [0, \rho]$, the indeterminacy membership function $(\emptyset_s) : R \to [\sigma, 1]$ and the falsity membership function $(\varphi_{\bar{s}}) : R \to [\omega, 1]$ are given as:

$$\theta_{\tilde{s}}(x)=\begin{cases}\theta_{sl1}(x), & g^1\le x<h^1\\ \theta_{\overline{sl2}}(x), & h^1\le x<i^1\\ \rho, & x=i^1\\ \theta_{\overline{sr1}}(x), & i^1\le x<j^1\\ \theta_{\overline{sr2}}(x), & j^1\le x<k^1\\ 0, & \textit{otherwise}\end{cases}\qquad \phi_{\tilde{s}}(x)=\begin{cases}\phi_{sl1}(x), & g^2\le x<h^2\\ \phi_{\overline{sl2}}(x), & h^2\le x<i^2\\ \sigma, & x=i^2\\ \phi_{\overline{sr1}}(x), & i^2\le x<j^2\\ \phi_{\overline{sr2}}(x), & j^2\le x<k^2\\ 1, & \textit{otherwise}\end{cases}$$

$$\varphi_{\tilde{s}}(x)=\begin{cases}\varphi_{sl1}(x), & g^3\le x<h^3\\ \varphi_{\overline{sl2}}(x), & h^3\le x<i^3\\ \omega, & x=i^3\\ \varphi_{\overline{sr1}}(x), & i^3\le x<j^3\\ \varphi_{\overline{sr2}}(x), & j^3\le x<k^3\\ 1, & \textit{otherwise}\end{cases}$$

Definition 2.5. *(Single Valued Linear Heptagonal Neutrosophic Number (SVL-HNN)) A single valued linear heptagonal neutrosophic number $\bar{S}$ is defined and described as*

$$\begin{aligned}\bar{S}=<&\left[(a_1,b_1,c_1,d_1,e_1,f_1,g_1);\rho\right],\\ &\left[(a_2,b_2,c_2,d_2,e_2,f_2,g_2);\sigma\right],\\ &\left[(a_3,b_3,c_3,d_3,e_3,f_3,g_3);\omega\right]>,\end{aligned}$$

where $\rho,\sigma,\omega\in[0,1]$The truth membership function $\theta_S:R\to[0,\rho]$, the indeterminacy membership function $\emptyset_S:R\to[\sigma,1]$, the falsity membership function $\varphi_{\bar{S}}:R\to[\omega,1]$ are given as

$$\theta_{\tilde{s}}(x)=\begin{cases}\frac{x-a_1}{b_1-a_1} & a_1\le x<b_1\\ \frac{x-b_1}{c_1-b_1} & b_1\le x<c_1\\ \frac{x-c_1}{d_1-c_1} & c_1\le x<d_1\\ 1 & x=d_1\\ \frac{e_1-x}{e_1-d_1} & d_1\le x<e_1\\ \frac{f_1-x}{f_1-e_1} & e_1\le x<f_1\\ \frac{g_1-x}{g_1-f_1} & f_1\le x<g_1\\ 0 & \textit{otherwise}\end{cases}\qquad \phi_{\bar{S}}(x)=\begin{cases}\frac{x-a_2}{b_2-a_2} & a_2\le x<b_2\\ \frac{x-b_2}{c_2-b_2} & b_2\le x<c_2\\ \frac{x-c_2}{d_2-c_2} & c_2\le x<d_2\\ 0 & x=d_2\\ \frac{e_2-x}{e_2-d_2} & d_2\le x<e_2\\ \frac{f_2-x}{f_2-e_2} & e_2\le x<f_2\\ \frac{g_2-x}{g_2-f_2} & f_2\le x<g_2\\ 1 & \textit{otherwise}\end{cases}$$

$$\varphi_{\bar{S}}(x) = \begin{cases} \frac{x-a_3}{b_3-a_3} & a_3 \le x < b_3 \\ \frac{x-b_3}{c_3-b_3} & b_3 \le x < c_3 \\ \frac{x-c_3}{d_3-c_3} & c_3 \le x < d_3 \\ 0 & x = d_3 \\ \frac{e_3-x}{e_3-d_3} & d_3 \le x < e_3 \\ \frac{f_3-x}{f_3-e_3} & e_3 \le x < f_3 \\ \frac{g_3-x}{g_3-f_3} & f_3 \le x < g_3 \\ 1 & otherwise \end{cases}$$

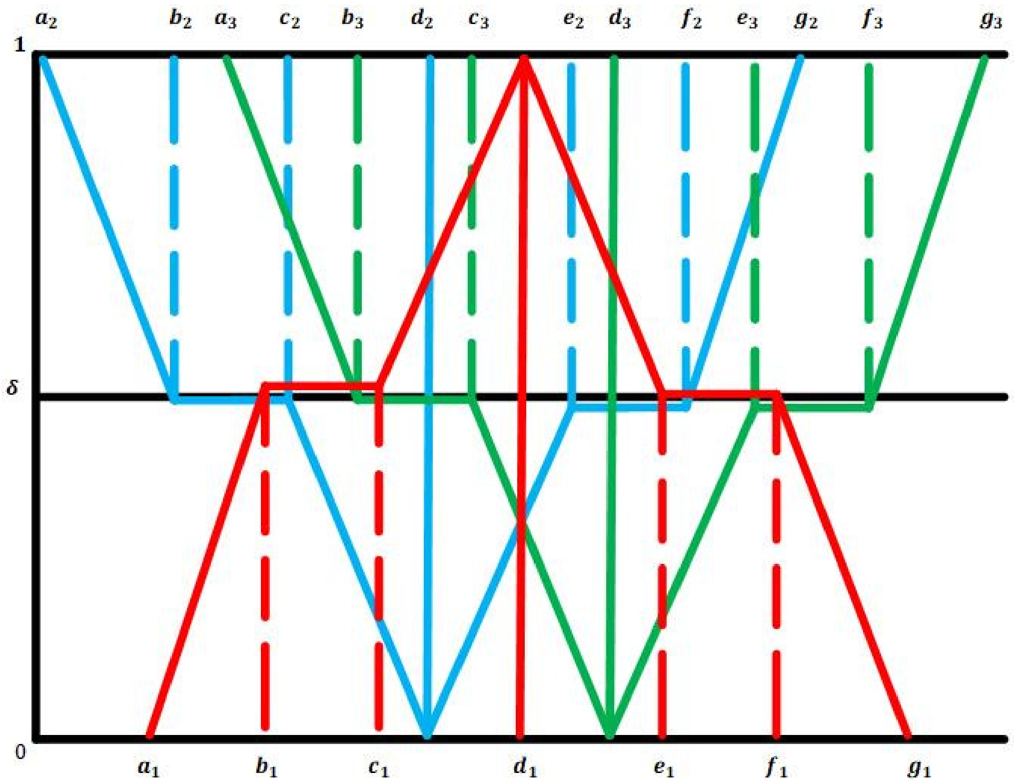

FIGURE 1

Graphical representation of single valued linear heptagonal neutrosophic number where red colour represent truth membership function, blue represent hesitation membership function, green colour represent falsity membership functions. Here $-0 \le \theta_{\tilde{S}}(x) + \phi_{\tilde{S}}(x) + \varphi_{\tilde{S}}(x) \le 3+$.

3. DE-NEUTROSOPHICATION OF SINGLE VALUED LINEAR HEPTAGONAL NEUTROSOPHICATION NUMBER

Research from all around the globe are concerned to know what shall the crisp value associating the neutrosophic number having membership function. They have continuously developed some convenient means to change a fuzzy number to crisp number. To transform a neutrosophic number to crisp number "**REMOVAL AREA METHOD**" is proposed in this paper. Considering single valued linear heptagonal Neutrosophic number

$$\tilde{A}_{neu} = (a_1, b_1, c_1, d_1, e_1, f_1, g_1; a_2, b_2, c_2, d_2, e_2, f_2, g_2; a_3, b_3, c_3, d_3, e_3, f_3, g_3).$$

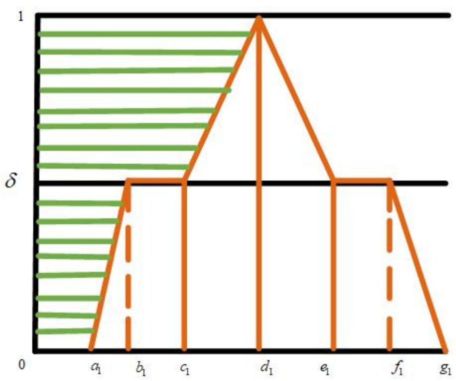

FIGURE 2. $\tilde{A}_{neul}(\hat{P}, 0)$

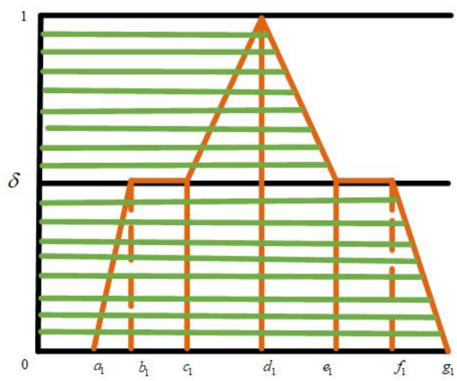

FIGURE 3. $\tilde{A}_{neur}(\hat{P}, 0)$

$$\begin{aligned}
\tilde{A}_{neu}(\hat{P}, 0) &= \tfrac{1}{2}[(\tilde{A}_{neul}(\hat{P}, 0) + \tilde{A}_{neur}(\hat{P}, 0))] \\
&= \tfrac{1}{2}[((a_1 + b_1)/2)\delta + ((b_1 + c_1)/2)\delta + ((c_1 + d_1)/2)(1 - \delta) \\
&\quad +((d_1 + e_1)/2)(1 - \delta) + ((e_1 + f_1)/2)\delta + ((f_1 + g_1)/2)\delta] \\
&= \tfrac{1}{2}[((a_1 + b_1 + b_1 + c_1 + e_1 + f_1 + f_1 + g_1)/2)\delta + ((c_1 + d_1 + d_1 + e_1)/2)(1 - \delta)] \\
&= \tfrac{1}{4}[(a_1 + 2b_1 + c_1 + e_1 + 2f_1 + g_1)\delta + (c_1 + 2d_1 + e_1)(1 - \delta)]
\end{aligned}$$

$$\begin{aligned}
\tilde{A}_{neu}(\hat{Q}, 0) &= \tfrac{1}{2}[(\tilde{A}_{neul}(\hat{Q}, 0) + \tilde{A}_{neur}(\hat{Q}, 0))] \\
&= \tfrac{1}{2}[((a_2 + b_2)/2)(1 - \delta) + ((b_2 + c_2)/2)(1 - \delta) + ((c_2 + d_2)/2)\delta \\
&\quad +((d_2 + e_2)/2)\delta + ((e_2 + f_2)/2)(1 - \delta) + ((f_2 + g_2)/2)(1 - \delta)] \\
&= \tfrac{1}{2}[((a_2 + b_2 + b_2 + c_2 + e_2 + f_2 + f_2 + g_2)/2)(1 - \delta) + ((c_2 + d_2 + d_2 + e_2)/2)\delta] \\
&= \tfrac{1}{4}[(a_1 + 2b_2 + c_2 + e_2 + 2f_2 + g_2)(1 - \delta) + (c_2 + 2d_2 + e_2)\delta].
\end{aligned}$$

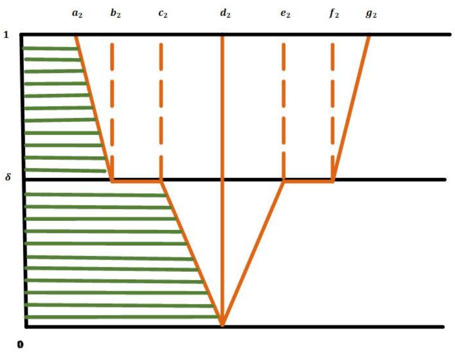

FIGURE 4. $\tilde{A}_{neu}(\hat{Q},0)$

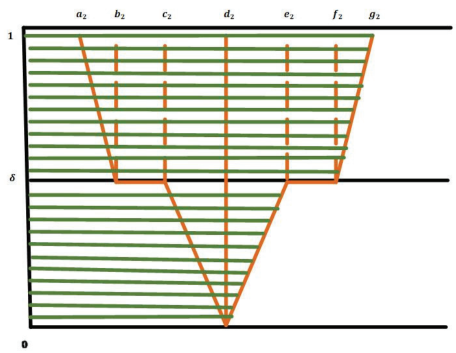

FIGURE 5. $\tilde{A}_{neul}(\hat{Q},0)$

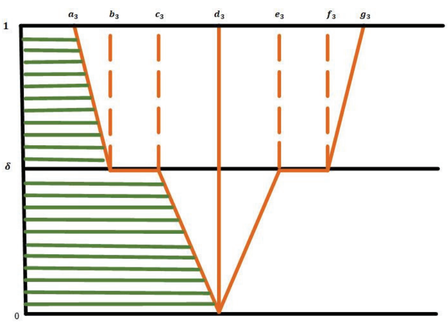

FIGURE 6. $\tilde{A}_{neul}(\hat{R},0)$

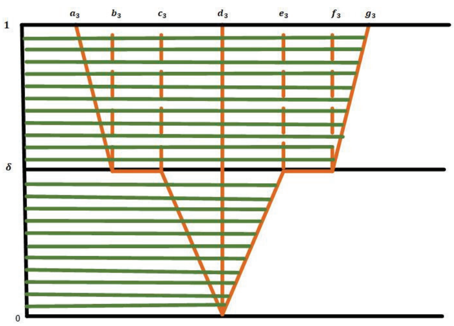

FIGURE 7. $\tilde{A}_{neur}(\hat{R},0)$

$$\begin{aligned}\tilde{A}_{neu}(\hat{R},0) &= \tfrac{1}{2}[(\tilde{A}_{neul}(\hat{R},0)+\tilde{A}_{neur}(\hat{R},0))]\\ &= \tfrac{1}{2}[((a_3+b_3)/2)(1-\delta)+((b_3+c_3)/2)(1-\delta)+((c_3+d_3)/2)\delta+((d_3+e_3)/2)\delta\\ &\quad +((e_3+f_3)/2)(1-\delta)+((f_3+g_3)/2)(1-\delta)]\\ &= \tfrac{1}{2}[((a_3+b_3+b_3+c_3+e_3+f_3+f_3+g_3)/2)(1-\delta)+((c_3+d_3+d_3+e_3)/2)\delta]\\ &= \tfrac{1}{4}[(a_3+2b_3+c_3+e_3+2f_3+g_3)(1-\delta)+(c_3+2d_3+e_3)\delta]\end{aligned}$$

$$\begin{aligned}\tilde{A}_{neu}(\tilde{D},0) &= \tfrac{1}{3}[\tilde{A}_{neu}(\tilde{P},0)+\tilde{A}(\tilde{Q},0)+\tilde{A}_{neu}(\tilde{R},0)]\\ &= \tfrac{1}{4}[(a_3+2b_3+c_3+e_3+2f_3+g_3)(1-\delta)+(c_3+2d_3+e_3)\delta]\end{aligned}$$

$$\tilde{A}_{neu}(\tilde{D},0) = \tfrac{1}{3}[\tilde{A}_{neu}(\tilde{P},0)+\tilde{A}(\tilde{Q},0)+\tilde{A}_{neu}(\tilde{R},0)]$$

$$\begin{aligned}A = \tfrac{1}{18}[&(a_1+2b_1+c_1+e_1+2f_1+g_1+c_2+2d_2+e_2+c_3+2d_3+e_3)\delta\\ &+(c_1+2d_1+e_1+a_1+2b_2+c_2+e_2+2f_2+g_2+a_3+2b_3\\ &+c_3+e_3+2f_3+g_3)(1-\delta)],\end{aligned}$$

4. Conclusion

In this article, the concept of single valued linear heptagonal neutrosophic number has been developed in a different aspect. Demonstration of De-Neutrosophication method utilizing the removal area technique has been introduced for conversion of a heptagonal neutrosophic number into a crisp number. This method is more fast, accurate and exact results after the total computation. Future work, this neutrosophic number can be extended for the better results and some of the algorithm can be introduced to get a new idea of getting the accurate result.

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DEPARTMENT OF MATHEMATICS,
HINDUSTAN INSTUTITUTE OF TECHNOLOGY AND SCIENCE,
CHENNAI, TAMILNADU, INDIA.
Email address: amalarichard01@gmail.com

DEPARTMENT OF MATHEMATICS,
HINDUSTAN INSTUTITUTE OF TECHNOLOGY AND SCIENCE,
CHENNAI, TAMILNADU, INDIA.
Email address: arajkumar@hindustanuniv.ac.in