Malaya Journal of Matematik, Vol. 8, No. 4, 1687-1690, 2020

https://doi.org/10.26637/MJM0804/0061

Bipolar soft neutrosophic topological region

G. Upender Reddy[1]* , T. Siva Nageswara Rao[2], N. Srinivasa Rao [3] and V. Venkateswara Rao [4]

Abstract

In this article deals, different areas with uncertainty data information in bipolar soft neutrosophic topology. In the past time, so many authors are discussed about neutrosophic and bipolar neutrosophic theory. Soft neutrosophic Set theory was derived by Maji. The present article extended to bipolar soft spatial region. Also we obtained definitions of Soft open, soft closed, soft pre-open, soft pre- closed on the bipolar neutrosophic.

Keywords

Soft neutrosophic set; bipolar soft neutrosophic topology; bipolar soft neutrosophic spatial areas.

AMS Subject Classification

11B05.

[1] *Department of Mathematics, Nizam College (A), Osmania University, Basheerbagh, Hyderabad, TS, India.*

[2,3, 4] *Department of Mathematics, Vignan's Foundation for Science Technology and Research(Deemed to be University), Vadlamudi, Guntur (Dt.), A.P, India.*

***Corresponding author**: yuviganga@gmail.com, shivathottempudi@gmail.com, srinudm@gmail.com, vunnamvenky@gmail.com.

Article History: Received **11** June **2020**; Accepted **13** September **2020**

Contents

1. Introduction

Everywhere in the world uncertainty situations are there in each case. In particularly mathematics there are different fields with uncertainty problems. Especially Fuzzy theory [14] and Intuitionist fuzzy theory [1] authors find out different problems deal with uncertainty. By overcome this uncertainty, Smarandache [8] derived neutrosophic theory. Maji [3] collective the two topics soft sets and neutrosophic theory. The author also have the some more research work on neutrosophic theory see the references [2, 4, 5, 6, 7, 9, 10, 11, 12, 13].

Notations:

1. Bipolar Soft Neutrosophic (BSN)
2. Bipolar soft Neutrosophic set (BSNS)
3. Bipolar soft neutrosophic pre-open sets (BSNPOS)
4. Bipolar soft neutrosophic pre-closed sets (BSNPCS).
5. Bipolar soft Neutrosophic topology (BSNT)
6. Bipolar soft neutrosophic closure (BSNC)
7. Bipolar soft neutrosophic interior (BSNI)
8. Bipolar soft neutrosophic open set (BSNOS)
9. Bipolar soft neutrosophic closed set(BSNCS)
10. Bipolar soft neutrosophic semi-closed(BSNSC)
11. Bipolar Soft neutrosophic semi open(BSNSO)

This article based on the soft neutrosophic topology. Here we start with some basic definitions.

2. Preliminaries

In this section, we recall some definitions and basic results of fractional calculus which will be used throughout the paper.

Definition 2.1. *(W,Z) is a soft set in Ω where $W : Z \to \tilde{P}(\Psi)$ is a mapping where $\tilde{P}(\Psi)$ is a power set of Ψ .*
We express (W,Z) by $\tilde{W}.\tilde{W} = \{(f, W(f)) : f \in Z\}$.

Definition 2.2. *A bipolar neutrosophic set B on* Ψ *is defined as:*
$B = \{< z, \varepsilon_{BN}(z), \phi_{BN}(z), \varphi_{BN}(z), \varepsilon_{BP}(z), \phi_{BP}(z), \varphi_{BP}(z) >: z \in \Psi\}$
where
$\varepsilon_{BP}, \phi_{BP}, \varphi_{BP} : \Psi \to]^{-}0, 1^{+}[$ *and*
$\varepsilon_{BN}, \phi_{BN}, \varphi_{BN} : \Psi \to] -1, 0[$ *and*
$^{-}3 \leq \varepsilon_{BN}(z) + \phi_{BN}(z) + \varphi_{BN}(z) + \varepsilon_{BP}(z) + \phi_{BP}(z) + \varphi_{BP}(z) \leq 3^{+}$

Definition 2.3. *Let* Ψ *be the set and Z be parameter set. Let* $\tilde{P}(\Psi)$ *represented the set of all BSNS of* Ψ. *Then* (W, Z) *is known as BSNS over* Ψ *where* $W : Z \to \tilde{P}(\Psi)$ *is a mapping.*
We express the BSNS (W, Z) *by* $\tilde{W}_{Nu}$.
That is, $\tilde{W}_{Nu} = \{(f, \{< z, \varepsilon_{N\tilde{W}_{Nu}}(z), \phi_{N\tilde{W}_{Nu}}(z), \varphi_{N\tilde{W}_{Nu}}(z), \varepsilon_{P\tilde{W}_{Nu}}(z), \phi_{P\tilde{W}_{Nu}}(z), \varphi_{P\tilde{W}_{Nu}}(z) >: z \in \Psi\}) f \in Z\}$.

Definition 2.4. *The complement of the BSNS* $\tilde{W}_{Nu}$ *is represented by* $(\tilde{W}_{Nu})^{C}$ *and is defined by*
$(\tilde{W}_{Nu})^{C} = \{(f, \{< z, \varphi_{N\tilde{W}_{Nu}}(z), \phi_{N\tilde{W}_{Nu}}(z), \varepsilon_{N\tilde{W}_{Nu}}(z), \varphi_{P\tilde{W}_{Nu}}(z), \phi_{P\tilde{W}_{Nu}}(z), \varepsilon_{P\tilde{W}_{Nu}}(z) >: z \in \Psi\}) f \in Z\}$

Definition 2.5. *For any two BSNS* $\tilde{W}_{Nu}$ *and* $\tilde{S}_{Nu}$ *over* Ψ, $\tilde{W}_{Nu}$ *is a BSN subset of* $\tilde{S}_{Nu}$ *if*
$\varepsilon_{N\tilde{W}_{Nu}}(z) \leq \varepsilon_{N\tilde{S}_{Nu}}(z)$; $\varepsilon_{P\tilde{W}_{Nu}}(z) \leq \varepsilon_{P\tilde{S}_{Nu}}(z)$
$\phi_{N\tilde{W}_{Nu}}(z) \leq \phi_{N\tilde{S}_{Nu}}(z)$; $\phi_{P\tilde{W}_{Nu}}(z) \leq \phi_{P\tilde{S}_{Nu}}(z)$
$\varphi_{N\tilde{W}_{Nu}}(z) \geq \varphi_{N\tilde{S}_{Nu}}(z)$; $\varphi_{P\tilde{W}_{Nu}}(z) \geq \varphi_{P\tilde{S}_{Nu}}(z)$
for all $f \in Z$ *and* $z \in \Psi$.

Definition 2.6. *A BSNS* $\tilde{W}_{Nu}$ *over* Ψ *is said to be null BSNS if*
$\varphi_{N\tilde{W}_{Nu}}(z) = 0$; $\varphi_{P\tilde{W}_{Nu}}(z) = 0$
$\phi_{N\tilde{W}_{Nu}}(z) = 0$; $\phi_{P\tilde{W}_{Nu}}(z) = 0$; $\varepsilon_{N\tilde{W}_{Nu}}(z) = 1$;
$\varepsilon_{P\tilde{W}_{Nu}}(z) = 1$ *for all* $f \in Z$ *and* $z \in \Psi$. *It is denoted by* $\Phi^{\oplus}_{Nu}$.

Definition 2.7. *A BSNS* $\tilde{W}_{Nu}$ *over* Ψ *is said to be absolute BSNS if*
$\varphi_{N\tilde{W}_{Nu}}(z) = 1$; $\varphi_{P\tilde{W}_{Nu}}(z) = 1$
$\phi_{N\tilde{W}_{Nu}}(z) = 1$; $\phi_{P\tilde{W}_{Nu}}(z) = 1$;
$\varepsilon_{N\tilde{W}_{Nu}}(z) = 0$; $\varepsilon_{P\tilde{W}_{Nu}}(z) = 0$ *for all* $f \in Z$ *and* $z \in \Psi$.
It is represented by $\tilde{\Psi}_{Nu}$

Definition 2.8. *The disjunction of two BSNS* $\tilde{W}_{Nu}$ *and* $\tilde{S}_{Nu}$ *is represented by* $\tilde{W}_{Nu} \cup \tilde{S}_{Nu}$ *and is defined by* $\tilde{U}_{Nu} = \tilde{W}_{Nu} \cup \tilde{S}_{Nu}$ *as follows*

$$\varepsilon_{N\tilde{U}_{Nu}}(z) = \begin{cases} \varepsilon_{N\tilde{W}_{Nu}}(z) & if\ f \in B - C \\ \varepsilon_{N\tilde{S}_{Nu}}(z) & if\ f \in C - B \\ \max\left\{\varepsilon_{N\tilde{W}_{Nu}}(z), \varepsilon_{N\tilde{S}_{Nu}}(z)\right\} & if\ f \in B \cap C \end{cases}$$

$$\varepsilon_{P\tilde{U}_{Nu}}(z) = \begin{cases} \varepsilon_{P\tilde{W}_{Nu}}(z) & if\ f \in B - C \\ \varepsilon_{P\tilde{S}_{Nu}}(z) & if\ f \in C - B \\ \max\left\{\varepsilon_{P\tilde{W}_{Nu}}(z), \varepsilon_{P\tilde{S}_{Nu}}(z)\right\} & if\ f \in B \cap C \end{cases}$$

$$\phi_{N\tilde{U}_{Nu}}(z) = \begin{cases} \phi_{N\tilde{W}_{Nu}}(z) & if\ f \in B - C \\ \phi_{N\tilde{S}_{Nu}}(z) & if\ f \in C - B \\ \max\left\{\phi_{N\tilde{W}_{Nu}}(z), \phi_{N\tilde{S}_{Nu}}(z)\right\} & if\ f \in B \cap C \end{cases}$$

$$\phi_{P\tilde{U}_{Nu}}(z) = \begin{cases} \phi_{P\tilde{W}_{Nu}}(z) & if\ f \in B - C \\ \phi_{P\tilde{S}_{Nu}}(z) & if\ f \in C - B \\ \max\left\{\phi_{P\tilde{W}_{Nu}}(z), \phi_{P\tilde{S}_{Nu}}(z)\right\} & if\ f \in B \cap C \end{cases}$$

$$\varphi_{N\tilde{U}_{Nu}}(z) = \begin{cases} \varphi_{N\tilde{W}_{Nu}}(z) & if\ f \in B - C \\ \varphi_{N\tilde{S}_{Nu}}(z) & if\ f \in C - B \\ \min\left\{\varphi_{N\tilde{W}_{Nu}}(z), \varphi_{N\tilde{S}_{Nu}}(z)\right\} & if\ f \in B \cap C \end{cases}$$

$$\varphi_{P\tilde{U}_{Nu}}(z) = \begin{cases} \varphi_{P\tilde{W}_{Nu}}(z) & if\ f \in B - C \\ \varphi_{P\tilde{S}_{Nu}}(z) & if\ f \in C - B \\ \min\left\{\varphi_{P\tilde{W}_{Nu}}(z), \varphi_{P\tilde{S}_{Nu}}(z)\right\} & if\ f \in B \cap C \end{cases}$$

Definition 2.9. *The conjunction of two BSNS* $\tilde{W}_{Nu}$ *and* $\tilde{S}_{Nu}$ *is represented by* $\tilde{W}_{Nu} \cap \tilde{S}_{Nu}$ *and is defined by* $\tilde{U}_{Nu} = \tilde{W}_{Nu} \cap \tilde{S}_{Nu}$ *, as follows*
$\varepsilon_{N\tilde{U}_{Nu}}(z) = \min\{\varepsilon_{N\tilde{W}_{Nu}}(z), \varepsilon_{N\tilde{S}_{Nu}}(z)\}$;
$\varepsilon_{P\tilde{U}_{Nu}}(z) = \min\{\varepsilon_{P\tilde{W}_{Nu}}(z), \varepsilon_{P\tilde{S}_{Nu}}(z)\}$
$\phi_{N\tilde{U}_{Nu}}(z) = \frac{\phi_{N\tilde{W}_{Nu}}(z) + \phi_{N\tilde{S}_{Nu}}(z)}{2}$;
$\phi_{P\tilde{U}_{Nu}}(z) = \frac{\phi_{P\tilde{W}_{Nu}}(z) + \phi_{P\tilde{S}_{Nu}}(z)}{2}$
$\varphi_{N\tilde{U}_{Nu}}(z) = \max\{\varphi_{N\tilde{W}_{Nu}}(z), \varphi_{N\tilde{S}_{Nu}}(z)\}$;
$\varphi_{P\tilde{U}_{Nu}}(z) = \max\{\varphi_{P\tilde{W}_{Nu}}(z), \varphi_{P\tilde{S}_{Nu}}(z)\}$

3. Bipolar Soft neutrosophic topological space

Definition 3.1. *Let BSNS*(Ψ, Z) *be the family of all BNSS over Z and* $\tilde{N}_{BS\tau*} \subset BSNS(\Psi, Z)$ *.Then* $\tilde{N}_{BS\tau*}$ *is known as bipolar soft neutrosophic topology (BSNT) on* (Ψ, Z) *if the subsequent circumstances are satisfied*
(i). $\tilde{\Phi}_{BNu}, \tilde{\Psi}_{BNu} \in \tilde{N}_{BS\tau*}$
(ii) $\tilde{N}_{BS\tau*}$ *is closed under arbitrary disjunction.*
(iii) $\tilde{N}_{BS\tau*}$ *is closed under infinite conjunction.*
Then the triplet $(\Psi, \tilde{N}_{BS\tau*}, Z)$ *is known as BSNT space.*
The elements of $\tilde{N}_{BS\tau*}$ *are known BSNOS in* $(\Psi, \tilde{N}_{S\tau*}, Z)$.
A BSNS $\tilde{W}_{BNu}$ *in BSNS*(Ψ, Z) *is soft closed in* $(\Psi, \tilde{N}_{BS\tau*}, Z)$ *if its complement* $(\tilde{W}_{BNu})^{C}$ *is BSNOS in* $(\Psi, \tilde{N}_{BS\tau*}, Z)$.
The BSN closure of $\tilde{W}_{BNu}$ *is the BSNS,*
$BN_u \approx SCL(\tilde{W}_{BNu}) = \cap\{\tilde{S}_{BNu} : \tilde{S}_{BNu}\ is\ bipolar\ neutrosophic\ soft\ closed\ and\ \tilde{W}_{BNu} \subseteq \tilde{S}_{BNu}\}$.
The BSN interior of $\tilde{W}_{Nu}$ *is the BNSS,*
$BN_u \approx SINT(\tilde{W}_{BNu}) = \cup\{\tilde{S}_{BNu} : \tilde{S}_{BNu}\ is\ bipolar\ neutrosophic\ soft\ closed\ and\ \tilde{W}_{BNu} \subseteq \tilde{S}_{BNu}\}$.
It is easy to see that
$\tilde{W}_{BNu}$ *is BSN open iff* $\tilde{W}_{BNu} = BN_u \approx SINT(\tilde{W}_{BNu})$ *and BSN closed if and only if* $BN_u \approx SCL(\tilde{W}_{BNu})$.

Theorem 3.2. *Let* $(\Psi, \tilde{N}_{BS\tau*}, Z)$ *be a BSNTS over* (Ψ, Z) *and* $\tilde{W}_{BNu}$ *and* $\tilde{S}_{BNu} \in (\Psi, Z)$ *then*
(i) $BN_u \approx SINT(\tilde{W}_{BNu}) \subset \tilde{W}_{BNu}$ *and* $BN_u \approx SINT(\tilde{W}_{BNu})$ *is the largest open set.*
(ii) $\tilde{W}_{BNu} \subset \tilde{W}_{BNu}$ *implies* $BN_u \approx SINT(\tilde{W}_{BNu}) \subset BN_u \approx SINT(\tilde{W}_{BNu})$
(iii) $BN_u \approx SINT(\tilde{W}_{BNu})$ *is an BSNOS.*
That is $BN_u \approx SINT(\tilde{W}_{BNu}) \in \tilde{N}_{BS\tau*}$

(iv) $\tilde{W}_{BNu}$ *is BSNO* $BN_u \approx SINT\left(\tilde{W}_{BNu}\right) = \tilde{W}_{BNu}$
(v) $BN_u \approx SINT\left(BN_u \approx SINT\left(\tilde{W}_{BNu}\right)\right)$
$= BN_u \approx SINT\left(\tilde{W}_{BNu}\right)$
(vi) $BN_u \approx SINT\left(\tilde{\Phi}_{BNu}\right) = \tilde{\Phi}_{BNu}, BN_u \approx SINT\left(\tilde{\Psi}_{BNu}\right)$
$= \tilde{\Psi}_{BNu}$ *(vii)* $BN_u \approx SINT\left(\tilde{W}_{BNu} \cap \tilde{S}_{BNu}\right) =$
$BN_u \approx SINT\left(\tilde{W}_{BNu}\right) \cap BN_u \approx SINT\left(\tilde{S}_{BNu}\right)$
(viii) $BN_u \approx SINT\left(\tilde{W}_{BNu}\right) \cup BN_u \approx SINT\left(\tilde{S}_{BNu}\right)$
$\subset BN_u \approx SINT\left(\tilde{W}_{BNu} \cup \tilde{S}_{BNu}\right)$

Theorem 3.3. *Let* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$*be a BSNTS* (Ψ, Z) *and* $\tilde{W}_{BNu}$ *and* $\tilde{S}_{BNu} \in (\Psi, Z)$ *then*
(i) $\tilde{W}_{BNu} \subset BN_u \approx SCL\left(\tilde{W}_{BNu}\right)$ *and* $BN_u \approx SCL\left(\tilde{W}_{BNu}\right)$ *are the smallest closed sets*
(ii) $\tilde{W}_{BNu} \subset \tilde{W}_{BNu}$ *implies* $BN_u \approx SCL\left(\tilde{W}_{BNu}\right)$
$\subset BN_u \approx SCL\left(\tilde{W}_{BNu}\right)$
(iii) $BN_u \approx SCL\left(\tilde{W}_{BNu}\right)$ *is BSNCS.*
That is $BN_u \approx SCL\left(\tilde{W}_{BNu}\right) \in \left(\tilde{N}_{BS\tau*}\right)^C$
(iv) $\tilde{W}_{BNu}$ *is bipolar neutrosophic soft closed*
$BN_u \approx SCL\left(\tilde{W}_{BNu}\right) = \tilde{W}_{BNu}$
(v) $BN_u \approx SCL\left(BN_u \approx SCL\left(\tilde{W}_{BNu}\right)\right)$
$= BN_u \approx SCL\left(\tilde{W}_{BNu}\right)$
(vi) $BN_u \approx SCL\left(\tilde{\Phi}_{BNu}\right) = \tilde{\Phi}_{BNu}$,
$BN_u \approx SCL\left(\tilde{\Psi}_{BNu}\right) = \tilde{\Psi}_{BNu}$
(vii)$BN_u \approx SCL\left(\tilde{W}_{BNu}\right) \cap BN_u \approx SCL\left(\tilde{S}_{BNu}\right)$
$\subset BN_u \approx SCL\left(\tilde{W}_{BNu} \cap \tilde{S}_{BNu}\right)$
(viii) $BN_u \approx SCL\left(\tilde{W}_{BNu}\right) \cup BN_u \approx SCL\left(\tilde{S}_{BNu}\right)$
$= BN_u \approx SCL\left(\tilde{W}_{BNu} \cup \tilde{S}_{BNu}\right)$

4. Bipolar soft neutrosophic nearly open sets

Definition 4.1. *Let* $\left(\Psi, \tilde{N}_{S\tau*}, Z\right)$ *be a BSNTS and* $\tilde{W}_{BNu}$ *be a BSNOS in* (Ψ, Z)*, then* $\tilde{W}_{BNu}$*is known as*
(i) Bipolar soft neutrosophic α*-open* $\Leftrightarrow$
$\tilde{W}_{BNu} \subseteq BN_u \approx SINT\left(BN_u \approx SCL\left(BN_u \approx SINT\left(\tilde{W}_{BNu}\right)\right)\right)$
(ii) Bipolar soft neutrosophic pre-open $\Leftrightarrow$
$\tilde{W}_{BNu} \subseteq BN_u \approx SINT\left(BN_u \approx SCL\left(\tilde{W}_{BNu}\right)\right)$
(iii) Bipolar soft neutrosophic semi-open $\Leftrightarrow$
$\tilde{W}_{BNu} \subseteq BN_u \approx SCL\left(BN_u \approx SINT\left(\tilde{W}_{BNu}\right)\right)$
(iv) Bipolar soft neutrosophic β*-open* $\Leftrightarrow$
$\tilde{W}_{BNu} \subseteq BN_u \approx SCL\left(BN_u \approx SINT\left(BN_u \approx SCL\left(\tilde{W}_{BNu}\right)\right)\right)$
(v) Bipolar soft neutrosophic regular-open $\Leftrightarrow$
$\tilde{W}_{BNu} \subseteq BN_u \approx SINT\left(BN_u \approx SCL\left(\tilde{W}_{BNu}\right)\right)$

Definition 4.2. *Let* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *be a BSNTS and e* $\tilde{W}_{BNu} \in (\Psi, Z)$*, then* $\tilde{W}_{Nu}$ *is known as*
(i) Bipolar soft neutrosophic α*-closed* $\Leftrightarrow$
$BN_u \approx SCL\left(BN_u \approx SINT\left(BN_u \approx SCL\left(\tilde{W}_{BNu}\right)\right)\right) \subseteq \tilde{W}_{BNu}$
(ii) Bipolar soft neutrosophic pre-closed $\Leftrightarrow$
$BN_u \approx SCL\left(BN_u \approx SINT\left(\tilde{W}_{BNu}\right)\right) \subseteq \tilde{W}_{BNu}$
(iii) Bipolar soft neutrosophic semi-closed $\Leftrightarrow$
$BN_u \approx SINT\left(BN_u \approx SCL\left(\tilde{W}_{BNu}\right)\right) \subseteq \tilde{W}_{BNu}$
(iv) Bipolar soft neutrosophic β*-closed* $\Leftrightarrow$
$BN_u \approx SINT\left(BN_u \approx SCL\left(BN_u \approx SINT\left(\tilde{W}_{BNu}\right)\right)\right)$
$\subseteq \tilde{W}_{BNu}$
(v) Bipolar soft neutrosophic regular-closed $\Leftrightarrow$
$\tilde{W}_{BNu} = BN_u \approx SCL\left(BN_u \approx SINT\left(\tilde{W}_{BNu}\right)\right)$

5. Bipolar soft neutrosophic region

Topology deals with surface area study in that analysis of Geographical information systems (GIS) and Geospatial databases. There is a lot of problems on the uncertainty on the regions. Further, go through the some definitions and proposals for a BSNT region, which supply a hypothetical structure for the modeling of BSNT relations surrounded by uncertain regions.

Definition 5.1. *Let* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *be a BNSTS over* (Ψ, Z) *and* $\tilde{W}_{BNu} \in BSNS(\Psi, Z)$*. Then BSN boundary of* $\tilde{W}_{BNu}$ *is defined by*
$\Im\tilde{W}_{BNu} = BN_u \approx SCL\left(\tilde{W}_{BNu}\right) \cap BN_u \approx SCL\left(\left(\tilde{W}_{BNu}\right)^C\right)$.

Definition 5.2. *Let* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *be a BSNTS over* (Ψ, Z)*. Then the BSN exterior of* $\tilde{W}_{BNu} \in BSNS(\Psi, Z)$ *is represented by* $\left(\tilde{W}_{BNu}\right)^{ext}$ *and is defined by*
$\left(\tilde{W}_{BNu}\right)^{ext} = BN_u \approx SINT\left(\left(\tilde{W}_{BNu}\right)^C\right)$

Theorem 5.3. *Let* $\tilde{W}_{BNu}$ *and* $\tilde{S}_{BNu}$ *be two BSNS over* (Ψ, Z)*. Then*

$$(i)\ \left(\tilde{W}_{BNu}\right)^{ext} = BN_u \approx SINT\left(\left(\tilde{W}_{BNu}\right)^C\right)$$

$$(ii)\ \left(\tilde{W}_{BNu} \cup \tilde{S}_{BNu}\right)^{ext} = \left(\tilde{W}_{BNu}\right)^{ext} \cap \left(\tilde{S}_{BNu}\right)^{ext}$$

$$(iii)\ \left(\tilde{W}_{BNu}\right)^{ext} \cup \left(\tilde{S}_{BNu}\right)^{ext} \subset \left(\tilde{W}_{BNu} \cap \tilde{S}_{BNu}\right)^{ext}$$

Theorem 5.4. *Let* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *be a BSNTS over* (Ψ, Z) *and* $\tilde{W}_{BNu}, \tilde{S}_{BNu} \in BSNS(\Psi, Z)$*.*
Then (i) $\left(\Im\tilde{W}_{BNu}\right)^C$
$= BN_u \approx SINT\left(\tilde{W}_{BNu}\right) \cup BN_u \approx SINT\left(\left(\tilde{W}_{BNu}\right)^C\right)$
(ii)$BN_u \approx SCL\left(\tilde{W}_{BNu}\right) = BN_u \approx SINT\left(\tilde{W}_{BNu}\right) \cup \Im\tilde{W}_{BNu}$
(iii) $\Im\tilde{W}_{BNu} = BN_u \approx SCL\left(\tilde{W}_{BNu}\right) \cap BN_u \approx SCL\left(\left(\tilde{W}_{BNu}\right)^C\right)$
(iv) $\Im\tilde{W}_{BNu} \cap BN_u \approx SINT\left(\tilde{W}_{BNu}\right) = \tilde{\Phi}_{BNu}$
(v) $\Im\left(\Im\left(\Im\left(\Im\tilde{W}_{BNu}\right)\right)\right) = \Im\left(\Im\tilde{W}_{BNu}\right)$

Definition 5.5. *Let* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *be a BSNTS over*(Ψ, Z)*. Then a couple of non-empty BSNOS are* $\tilde{W}_{BNu}, \tilde{S}_{BNu}$ *is known as a BSN separation of* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *if*
$\tilde{\Psi}_{BNu} = \tilde{W}_{BNu} \cup \tilde{S}_{BNu}$ *and* $\tilde{W}_{BNu} \cap \tilde{S}_{BNu} = \tilde{\Phi}_{BNu}$

Definition 5.6. *A BSNTS* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *is known as BSN connected if there does not present a BSN separation of* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$.
Otherwise $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *is known as BSN disconnected.*
Next, we go through a model for spatial BSN region based on BSN connectedness.

Definition 5.7. *Let* $\left(\Psi, \tilde{N}_{BS\tau*}, Z\right)$ *be a BSNTS. A spatial BSN region in* (Ψ, Z) *is a non empty BSN subset* $\tilde{W}_{BNu}$ *such that*
(i) $BN_u \approx SINT\left(\tilde{W}_{BNu}\right)$ *is BSN connected.*
(ii) $\tilde{W}_{BNu} = BN_u \approx SCL\left(BN_u \approx SINT\left(\tilde{W}_{BNu}\right)\right)$

6. Conclusion

In this article, Bipolar soft neutrosophic topological region explained on soft open, soft closed, soft pre-open and soft pre-closed on the bipolar neutrosophic theory. We discussed about some basic definitions about neutrosophic topological space, bipolar soft neutrosophic set etc.,. Further we obtained the results based on soft open and soft closed with similar results soft pre-open and soft pre-closed sets on topological region.

References

[1] K. Atanassov, Intuitionstic fuzzy sets, *Fuzzy Set Syst.,* 20(1986), 87–96.

[2] Ch. Shashi Kumar,T. Siva Nageswara Rao,Y. Srinivasa Rao,V. Venkateswara Rao,Interior and Boundary vertices of BSV Neutrosophic Graphs, *Jour. of Adv. Research in Dynamical & Control Systems,* 12(6)(2020),1510-1515.

[3] P.K. Maji, Neutrosophic soft set, *Annals of Fuzzy Mathematics and Informatics,* 5(1)(2013), 157–168.

[4] S. Broumi, A. Bakali, M. Talea, F.Smarandache and V. Venkateswara Rao, Interval Complex Neutrosophic Graph of Type 1, *Neutrosophic Operational Research,* (2018), 88–107.

[5] S. Broumi, A. Bakali, M. Talea, F.Smarandache and V. Venkateswara Rao, Bipolar Complex Neutrosophic Graphs of Type 1, *New Trends in Neutrosophic Theory and Applications,* 2(2018), 189-208.

[6] S. Broumi, M. Talea, A. Bakali, F.Smarandache, Prem Kumar Singh, M. Murugappan, and V. Venkateswara Rao, Neutrosophic Technique Based Efficient Routing Protocol For MANET Based On Its Energy And Distance, *Neutrosophic Sets and Systems,* 24 (2019), 61–69.

[7] S. Broumi, P. K. Singh, M. Talea, A. Bakali, F. Smarandache and V.Venkateswara Rao, Single-valued neutrosophic techniques for analysis of WIFI connection, *Advances in Intelligent Systems and Computing,* 915(2013), 405–512.

[8] F. Smarandache, Neutrosophic set- a generalization of the intuitionstic fuzzy set, *International Journal of Pure and Applied Mathematics,* 24(3)(2005), 287–294.

[9] F. Smarandache, S. Broumi, P.K. Singh, C. Liu, V. Venkateswara Rao, H.-L. Yang and A. Elhassouny, Introduction to neutrosophy and neutrosophic environment, *In Neutrosophic Set in Medical Image Analysis*, (2019), 3–29.

[10] T. Siva Nageswara Rao, Ch. Shashi Kumar,,Y. Srinivasa Rao, V. Venkateswara Rao, Detour Interior and Boundary vertices of BSV Neutrosophic Graphs, *International Journal of Advanced Science and Technology,* 29(8)(2020), 2382-2394.

[11] T. Siva Nageswara Rao, G. Upender Reddy, V. Venkates wara Rao, Y. Srinivasa Rao, Bipolar Neutrosophic Weakly BG^* - Closed Sets, *High Technology Letters*, 26(8)(2020), 878–887.

[12] V. Venkateswara Rao,Y. Srinivasa Rao, Neutrosophic Pre-open Sets and Pre-closed Sets in Neutrosophic Topology, *International Journal of Chem Tech Research,* 10(10)(2017), 449- 458.

[13] Y. Srinivasa Rao, Ch. Shashi Kumar, T. Siva Nageswara Rao, V. Venkateswara Rao, Single Valued Neutrosophic detour distance, *Journal of Critical Reviews*, 7(8)(2020), 810–812.

[14] L.A. Zadeh, Fuzzy sets, *Information and Control*, 8(3)(1965), 338–353.

⋆⋆⋆⋆⋆⋆⋆⋆⋆
ISSN(P):2319 − 3786
Malaya Journal of Matematik
ISSN(O):2321 − 5666
⋆⋆⋆⋆⋆⋆⋆⋆⋆