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Bipolar Pre Semi-Open Neutrosophic Sets

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Abstract **-** In this present manuscript we enlarge the topological study to bipolar neutrosophic topological study. Previously on the neutrosophic theory many authors' gives results on the open and closed sets in neutrosophic topological with semi conditions have been discussed. In addition particularly, present article enlarge up to pre- semi open sets with respect to bipolar neutrosophic theory (PSOBNT).

Keywords: *Neutrosophic set, Bipolar Neutrosophic Topology, Bipolar Neutrosophic pre-semi open set.*

INTRODUCTION

In neutral reports is gives the base of the neutrosophic technique. This technique derived "Florentin Smarandache"at the time 1995. Neutrosophic technique is consequent from Fuzzy or intuitionistic Fuzzy technique. In the year 1988 on sets, logic and probability topics are reciprocated with neutrosophic technique [1].

Neutrosophic technique means to discover ordinary features to not ordinary values. T, I, F are known as neutrosophic values they stand for the truth, indeterminacy and false membership.A technique in this every intention is projected contain the entitlement of T the entitlement of I and entitlement of F where $0 \leq T + I + F \leq 3$ they are many neutrosophic rules of inference [2].

In this [3] demonstrated fuzzy concept while a numerical instrument intended for considering uncertainties where all elements had every input obtain See [4]. The intuitionistic fuzzy logicwas derived via Atanassov [4] when the overview of fuzzy anywhere as well the contribution with each component. In 2012 Salama, Alblow [5] established the model of topology. In 2016 derived the idea of the neutrosophic topology. The author also have the some more research work on neutrosophic theory see the references [11-19].

In this article, evaluate the bipolar pre-open neutrosophic sets (BPONS) in bipolar neutrosophic topological spaces. The topological spaces with respect to fuzzy theory has been discussed.

On intuitionistic points and intuitionisticsets,relations on soft sets with respect to neutrosophic theory and some of its properties, different operations on soft neutrosophic sets and soft neutrosophic topological spaceseliberate by many authors [6].These uncertainty idea comes from the theories of fuzzy sets [7], intuitionistic fuzzy sets [4, 6] and interval valued intuitionistic fuzzy sets [5].Ozturk T and Shabir M[12, 17] are successfully established a new approach to operate on neutrosophic soft sets to neutrosophic soft topological spaces. In the present study, we are discussing more on soft topological compact space with respect to bipolar neutrosophic theory, and also continuous the work on soft topological space with separation axioms and the Neutrosophic sets are a great exact implement for the situation uncertainty in the real world. The compactness on soft neutrosophic spaces with metric also very importent [8-10].

Venkateswara Rao etal., introduces pre-open sets and pre-closed sets in neutrosophic topology and extended this study complex neutrosophic graphs with Broumi[20, 21]. Upender Reddy etal., extend the neutrosophic theory to bipolar single valued theory on graphs as well as bipolar topological neutrosophic set and intuitionistic fuzzy topological soft spaces, in this the authors are given the basic definitions and some of the results on topological soft spaces. [22]. Siva Nageswara Rao etal., collaborated work on bipolar neutrosophic weekly closed sets and interior and boundary vertices on bipolar neutrosophic graphs [23-25]. Siva Nageswara rao et al., demonstrate a new trend in neutrosophic theory in probability, decision making problems, graph theory, topological space, soft sets relations and some properties[26-28].

PRELIMINARIES

We remember several essential terminologyexacting study of Smarandache [1], terminology based on Atanassov in [4, 5] and notations based on Salama [8, 9].

Notations:

1. Neutrosophic set (NS)
2. Bipolar Neutrosophic set (BNS)
3. Bipolar pre-semi open neutrosophic sets (BPSONS)
4. Bipolar pre-semi closed neutrosophic sets (BPSCNS).
5. Bipolar pre-open neutrosophic sets (BPONS)
6. Bipolar pre-closed neutrosophic sets (BPCNS).
7. Bipolar Neutrosophic topology (BNT)
8. Bipolar neutrosophic closure (BNC)
9. Bipolar neutrosophic interior (BNI)
10. Bipolar neutrosophic open set (BNOS)
11. Bipolar neutrosophic closed set(BNCS)
12. Bipolar neutrosophic semi-closed(BNSC)
13. Bipolar neutrosophic semi open(BNSO)

Definition 2.1: A Neutrosophic set (NS) is triplet structure (T, I, F) which is the degree of contribution functions with the circumstance $0 \le T + I + F \le 3$ and also lies among 0 and 1.**[7]**

Definition 2.2: A Bipolar Neutrosophic set (BNS) is the structure having six values in that three are positive and remaining three are negative. The structure is $\left(T^N, I^N, F^N, T^P, I^P, F^P\right)$ and also the negative values lies between [-1,0] and positive values lies between [0,1].

Definition 2.3: Let $S_1 = \left(T_{S_1}, I_{S_1}, F_{S_1}\right)$ and $S_2 = \left(T_{S_2}, I_{S_2}, F_{S_2}\right)$ are the BNSin that consider two possible cases for subsets.

1. $S_1 \subseteq S_2 \Leftrightarrow T_{s_1} \le T_{s_1}, I_{s_1} \le I_{s_2}$ *and* $F_{s_1} \ge F_{s_2}$.

2. $S_1 \subseteq S_2 \Leftrightarrow T_{s_1} \le T_{s_1}, I_{s_1} \ge I_{s_2}$ *and* $F_{s_1} \ge F_{s_2}$.

Definition 2.4: Let $S_1 = \left(T_{S_1}, I_{S_1}, F_{S_1}\right)$ and $S_2 = \left(T_{S_2}, I_{S_2}, F_{S_2}\right)$ are the BNSthen following may be defined as

$(I_1) S_1 \cap S_2 = T_{S_1} \wedge T_{S_2}, I_{S_1} \wedge I_{S_2}, F_{S_1} \vee F_{S_2}$

$(I_1) S_1 \cup S_2 = T_{S_1} \vee T_{S_2}, I_{S_1} \wedge I_{S_2}, F_{S_1} \wedge F_{S_2}$

Proposition 2.5: Let $S_1 = \left(T_{S_1}, I_{S_1}, F_{S_1}\right)$ and $S_2 = \left(T_{S_2}, I_{S_2}, F_{S_2}\right)$ are the BNSthen the subsequent situation are holds.

(1) $BNC(S_1 \cap S_2) = BNC(S_1) \cup BNC(S_2)$

(2) $BNC(S_1 \cup S_2) = BNC(S_1) \cap BNC(S_2)$

Definition 2.6: A BNT is a non-empty set W is a family $B\tau_N$ of a BNS in W holding the subsequent situation.

$\left(BNT_1\right)$ $0,1 \in B\tau_N$

$\left(BNT_2\right)$ $S_1 \cap S_2 \in B\tau_N$ for any $S_1, S_2 \in B\tau_N$

$\left(BNT_3\right)$ $\cup S_i \in B\tau_N$ for every $\{S_i : i \in I\} \subseteq B\tau_N$

Therefore $\left(W, B\tau_N\right)$ is BNT.

Example 2.7:

Let $W = \{w\}$ and

$$P = \{< w, -0.2, -0.1, -0.5 : 0.4, 0.4, 0.3 >: w \in W\}$$

$$Q = \{< w, -0.2, -0.6, -0.4; 0.3, 0.4, 0.7 >: w \in W\}$$

$$R = \{< w, -0.6, -0.3, -0.2 : 0.4, 0.5, 0.3 >: w \in W\}$$

$S = \{< w, -0.7, -0.2, -0.5 : 0.4, 0.6, 0.8 >: w \in W\}$

Then the family $\tau = \{0_N, 1_N, P, Q, R, S\}$ of bipolar neutrosophic set in W is bipolar neutrosophic topology W.

Definition 2.8: Let $(W, B\tau_N)$ be BNT space $S_1 = \langle T_{S_1}, I_{S_1}, F_{S_1} \rangle$ be a BNSin W then BNC and BNI of S_1 are defined as follows

$$BNcl(S_1) = \cap\{R_1, r_1 \text{ is a BNcs in} W \text{ and } S_1 \subseteq R_1\}$$

$$BN\operatorname{int}(S_1) = \cup\{R_2, r_2 \text{ is a BNos in} W \text{ and } R_2 \subseteq S_1\}$$

It preserves as well show that $BNcl(S_1)$ is BNC set and $BN\operatorname{int}(S_1)$ is BNO set in W.

(i) S_1 is BNOS $\Leftrightarrow S_1 = BN\operatorname{int}(S_1)$

(ii) S_1 is BNCS $\Leftrightarrow S_1 = BNcl(S_1)$

Proposition 2.9: Let $(W, B\tau_N)$ be BNT space and $S_1 \in (W, B\tau_N)$ we have

$(a)\ BNcl(C(S_1)) = C(BN\operatorname{int}(S_1))$

$(b)\ BN\operatorname{int}(C(S_1)) = C(BNcl(S_1))$

Proposition 2.10: Let $(W, B\tau_N)$ be BNT space and S_1, S_2 are two BNS in W then the subsequent rules are hold.

$a)\ BN\operatorname{int}(S_1) \subseteq S_1$

$b)\ S_1 \subseteq BNcl(S_1)$

$c)\ S_1 \subseteq S_2 \Rightarrow BN\operatorname{int}(S_1) \subseteq BN\operatorname{int}(S_2)$

$d)\ S_1 \subseteq S_2 \Rightarrow BNcl(S_1) \subseteq BNcl(S_2)$

$e)\ BN\operatorname{int}(BN\operatorname{int}(S_1)) = BN\operatorname{int}(S_1)$

$f)\ BNcl(BNcl(S_1)) = BNcl(S_1)$

$g)\ BN\operatorname{int}(S_1 \cap S_2) = BN\operatorname{int}(S_1) \cap BN\operatorname{int}(S_2)$

$h)\ BNcl(S_1 \cup S_2) = BNcl(S_1) \cup BNcl(S_2)$

$i)\ BN\operatorname{int}(0_N) = BNcl(0_N) = 0_N$

$j)\ BN\operatorname{int}(1_N) = BNcl(1_N) = 1_N$

$k)\ S_1 \subseteq S_2 \Rightarrow BNC(S_1) \subseteq BNC(S_2)$

$l)\ BNcl(S_1 \cap S_2) \subseteq BNcl(S_1) \cap BNcl(S_2)$

$m)\ BN\operatorname{int}(S_1 \cup S_2) \supseteq BN\operatorname{int}(S_1) \cup BN\operatorname{int}(S_2)$

Definition 2.11: Let $(W, B\tau_N)$ be BNT space and $S_1 = (T_{S_1}, I_{S_1}, F_{S_1})$ be a BNS in W then S_1 is a BNSO if $S_1 \subseteq BNcl(BN\operatorname{int}(S_1))$ and also BNSC if $BN\operatorname{int}(BNcl(S_1)) \subseteq S_1$.

The complement of BNSO set is a BNSC set.

BIPOLAR PRE-SEMI OPEN NEUTROSOPHIC SETS (BPSONS):

Definition 3.1: Let S_1 be BNS of a BNT spaces W. Then S_1 is known as BPSONS of W if there exists a BNO set such that $BNSO \subseteq A \subseteq BNSO\left(BNScl\left(A\right)\right)$.

Theorem3.2: Any subset S_1 in a $BNTS\ W$ is $BNSCS$ set iff $A \subseteq BN\operatorname{int}\left(BNScl\left(A\right)\right)$

Proof: Suppose $S_1 \subseteq BN\operatorname{int}\left(BNScl\left(S_1\right)\right)$

We know that $BNSO = BN\operatorname{int}\left(S_1\right)$

$BNSO \subseteq S_1 \subseteq BNSO\left(BNScl\left(S_1\right)\right)$.

Therefore S_1 is $BNPSOS$.

On the other hand, assume that Let S_1 be $BNPSC$ contained in W

$BNSO \subseteq S_1 \subseteq BNSO\left(BNScl\left(S_1\right)\right)$ for some $BNSO$

But $BNSO \subseteq BN\operatorname{int}\left(S_1\right)$, thus $BNSO\left(BNScl\left(S_1\right)\right) \subseteq BN\operatorname{int}\left(BNScl\left(S_1\right)\right)$

Hence $S_1 \subseteq BNSO\left(BNScl\left(S_1\right)\right) \subseteq BN\operatorname{int}\left(BNScl\left(S_1\right)\right)$

Therefore $S_1 \subseteq BN\operatorname{int}\left(BNScl\left(S_1\right)\right)$

Hence proved the theorem

Theorem 3.3 Consider $\left(W, B\tau_N\right)$ be a BNT spaces. Then disjunction of two BPSONS is also a BPSONS.

Proof: Let S_1 and S_2 are BPSONS in W.

$S_1 \subseteq BN\operatorname{int}\left(BNScl\left(S_1\right)\right)$

$S_2 \subseteq BN\operatorname{int}\left(BNScl\left(S_2\right)\right)$

Therefore $S_1 \cup S_2 \subseteq BN\operatorname{int}\left(BNScl\left(S_1\right)\right) \cup BNScl\left(S_2\right)$

$S_1 \cup S_2 \subseteq BN\operatorname{int}\left(BNScl\left(S_1\right) \cup BNScl\left(S_2\right)\right)$

$S_1 \cup S_2 \subseteq BN\operatorname{int}\left(BNScl\left(S_1 \cup S_2\right)\right)$

By the definition $S_1 \cup S_2$ is a BPSONS in W.

Theorem3.4: Consider $\left(W, B\tau_N\right)$ be a BNT spaces. If $\left\{S_\alpha\right\}_{\alpha\in\Delta}$ is a collection of $BNPSO$ sets in a $BNTS\ W$ then $\cup_{\alpha\in\Delta} S_\alpha$ is $BNPSO$ set in W.

Proof: For each $\alpha \in \Delta$, we have a $BNSO_\alpha$ such that

$BNSO_\alpha \subseteq S_\alpha \subseteq BNSO_\alpha\left(BNScl\left(S\right)\right)$,

then $\cup_{\alpha\in\Delta} BNSO_\alpha \subseteq \cup_{\alpha\in\Delta} S_\alpha \subseteq \cup_{\alpha\in\Delta} BNSO_\alpha\left(BNScl\left(S\right)\right)$

$\cup_{\alpha\in\Delta} S_\alpha \subseteq \cup_{\alpha\in\Delta} BN\operatorname{int}_\alpha\left(BNScl\left(S\right)\right)$

Hence theorem proved.

Theorem 3.5: Every BNOS in the $BNTS$ in W is $BNPSO$ set in W.

Proof: let S_1 be $BNSO$ set in $BNTS$.

Then $S_1 = BNS\operatorname{int}(S_1)$

Clearly $S_1 \subseteq BNScl(S_1)$

$BNS\operatorname{int}(S_1) \subseteq BNS\operatorname{int}(BNScl(S_1))$

$S_1 \subseteq BNS\operatorname{int}(BNScl(S_1))$

S_1 is a $BNPSO$ set in W.

Theorem 3.6: Let S_1 be BPSONS in the BNT space W and suppose $S_1 \subseteq S_2 \subseteq BNScl(S_1)$ then S_2 is BPSONS in W.

Proof: Let S_1 be $BNSO$ set in BNT space W.

Then $S_1 = BNS\operatorname{int}(S_1)$ also

$S_1 \subseteq BNScl(S_1)$

$BNS\operatorname{int}(S_1) \subseteq BNS\operatorname{int}(BNScl(S_1))$

$S_1 \subseteq BNS\operatorname{int}(BNScl(S_1))$

Hence the theorem proved.

Lemma3.7: Let S_1 be $BNSO$ set in W and S_2 a BPSONS in W then there exists an $BNSO$ set P in W such that $S_2 \subseteq P \subseteq BNScl(S_1)$ it follows that

$S_1 \cap S_2 \subseteq S_1 \cap P \subseteq S_1 \cap BNScl(S_2) \subseteq BNScl(S_1 \cap S_2)$

In view of the fact that $S_1 \cap P$ is open, from the above (Theorem 3.6) lemma, $S_1 \cap S_2$ is BPSONS in W.

Proposition 3.8: Let W_1 and W_2 are BNT spaces such that W_1 is BN multiplication associated to W_2 then the BN multiplication associated $S_1 \times S_2$ of a BPSONS S_1 of W and a BPSONS S_2 of W_2 is a BPSONS of the BNmultiplication associated topological space $W_1 \times W_2$.

Proof: Let $0_1 \subseteq S_1 \subseteq BNScl(0_1)$ and $0_2 \subseteq S_2 \subseteq BNScl(0_2)$

Then $0_1 \times 0_2 \subseteq S_1 \times S_2 \subseteq BNScl(0_1) \times BNScl(0_2)$

$0_1 \times 0_2 \subseteq S_1 \times S_2 \subseteq BNScl(0_1 \times 0_2)$

$BN\operatorname{int}(0_1 \times 0_2) \subseteq BNS\operatorname{int}(S_1 \times S_2) \subseteq BNS\operatorname{int}(BNScl(0_1 \times 0_2))$

$0_1 \times 0_2 \subseteq S_1 \times S_2 \subseteq BNS\operatorname{int}(BNScl(0_1 \times 0_2))$

Hence $S_1 \times S_1$ is $BNPSO$ set in $W_1 \times W_2$

INTERPRETATIONS

At this particular context, we successfully demonstrated the idea of neutrosophic bipolar topological Pre-semi open sets and their properties. Also we discussed bipolar pre-semi Open sets with respect to neutrosophic theory. Further we obtained the relationship between NBPSOS and NBS separation theorem. And also we use these results for future work.

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