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Soft b Connectedness in Soft Tritopological Spaces

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ABSTRACT

This paper deals Soft tritopological spaces which is based on soft bitopological spaces. The characteristic of trio separated soft b sets and trio connected soft b sets were discussed. The final observation in this paper will extended to future study on soft tritopological spaces.

Keywords: trio separated soft b sets, trio connected soft b sets

1.INTRODUCTION

In 1999, Molodtsov.D [9] instituted soft sets theory as a new mathematical device for dealing with undetermine objects and to solve complex problems in engineering,economics, medicines, computer science, social sciences and environment. In 2012, H.Hazra, P.Majumadav, S.K.Samanta[7] instigated the notions of topology on soft subsets and softtopology.In 2017, Asmhan Flieh Hassan [1]set forth some new definitions of soft open sets in soft tritopological spaces. In 2014, Sabir Hussain[12] developed the properties and description of soft connected spaces in soft topological spaces. In 2017,N.Revathi and K.Bageerathi [11] introduced the concept of $(1,2)^*$ soft b separated sets and $(1,2)^*$ soft b connected spaces. In 2015, Sabir Hussain[14] introduced properties of soft semi open and soft semi closed sets. This paper discusses the concept and properties of trio soft b separated sets and trio soft b connected sets in the soft tritopological spaces.

2. PREMILARIES

Definition 2.1[3,5,6]

A set X along with three other topologies is called soft tritopological space .

Shown as $(X, \tau_1, \tau_2, \tau_3)$.

Definition 2.2[3,5,6]

Soft tritopological space is $(X,\tau_1,\tau_2,\tau_3,E)$ and $(A,E)\subseteq X$ and then (A,E) be called $(1,2,3)^*$ open soft b-set

$(A,E)\subseteq \tau_{1,2,3}-\text{int}(\tau_{1,2,3}-cl(A,E))\cup\tau_{1,2,3}-cl(\tau_{1,2,3}-\text{int}(A,E))$

Definition 2.3[3,5,6]

Soft tritopological space is $(X,\tau_1,\tau_2,\tau_3,E)$ and $(A,E)\subseteq \bar{X}$ .Hence (A,E) be called $(1,2,3)^*$ closed soft b set if $\tau_{1,2,3}-int(\tau_{1,2,3}-cl(A,E))\cup\ \tau_{1,2,3}-cl(\tau_{1,2,3}-int(A,E))\subseteq(A,E)$

Definition 2.4[11]

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Soft bitopological space is (X,τ_1,τ_2,E). Two non-empty disjoint soft subsets F_{E_1} and F_{E_2} of $\bar{X}$ are called $(1,2)^*$soft separated sets over X if $\left(\tau_{1,2}-cl(F_{E_1})\right)\cap F_{E_2}=F_{E_1}\cap\left(\tau_{1,2}-cl(F_{E_2})\right)=\emptyset$.

Definition 2.5[11]

Soft bitopological space is (X,τ_1,τ_2,E). Hence X is called $(1,2)^*$ soft b connected space if $\bar{X}$ cannot be indicated as the union of soft two $(1,2)^*$ soft b separated sets.

3. TRIO SEPARATED SOFT B SETS

Definition 3.1

Two not-empty soft subsets A_{E_1} and A_{E_2} of $\bar{X}$ are mentioned to be disjoint if $A_{E_1}\cap A_{E_2}=\emptyset$.

Definition 3.2

. Two not-empty soft disjoint subsets A_{E_1} and A_{E_2} of $\bar{X}$ are called trio separated soft sets over X if $\left(\tau_{1,2,3}-cl(A_{E_1})\right)\cap A_{E_2}=A_{E_1}\cap\left(\tau_{1,2,3}-cl(A_{E_2})\right)=\emptyset$.

Definition 3.3

Soft tritopological space is $(X,\tau_1,\tau_2,\tau_3,E)$.Two non-empty soft disjoint subsets A_{E_1} and A_{E_2} of $\bar{X}$ are called trio separated soft b set over X if $\left(\tau_{1,2,3}-sbcl(A_{E_1})\right)\cap A_{E_2}=A_{E_1}\cap\left(\tau_{1,2,3}-sbcl(A_{E_2})\right)=\emptyset$.

Definition 3.4

A trio separation soft b set of a soft tritopological space $(X,\tau_1,\tau_2,\tau_3,E)$ is a pair of trio separated soft b sets A_{E_1} and A_{E_2} whose soft union is $\bar{X}$.

Example 3.5

Let $X=\{l,m\}$,$E=M=\{e_1,e_2\}$ and$\bar{X}=\{(e_1,\{l,m\}),(e_2,\{l,m\})\}$ .The soft subsets are

$$A_{E_1}=\{(e_1,\{l\}),(e_2,\{l\})\}\quad A_{E_9}=\{(e_1,\{X\}),(e_2,\{l\})\}$$

$$A_{E_2}=\{(e_1,\{l\}),(e_2,\{m\})\}\quad A_{E_{10}}=\{(e_1,\{X\}),(e_2,\{m\})\}$$

$$A_{E_3}=\{(e_1,\{l\}),(e_2,\{X\})\}\quad A_{E_{11}}=\{(e_1,\{X\}),(e_2,\{X\})\}$$

$$A_{E_4}=\{(e_1,\{l\}),(e_2,\{\emptyset\})\}\quad A_{E_{12}}=\{(e_1,\{X\}),(e_2,\{\emptyset\})\}$$

$$A_{E_5}=\{(e_1,\{m\}),(e_2,\{l\})\}A_{E_{13}}=\{(e_1,\{\emptyset\}),(e_2,\{l\})\}$$

$$A_{E_6}=\{(e_1,\{m\}),(e_2,\{m\})\}\quad A_{E_{14}}=\{(e_1,\{\emptyset\}),(e_2,\{m\})\}$$

$$A_{E_7}=\{(e_1,\{m\}),(e_2,\{X\})\}\quad A_{E_{15}}=\{(e_1,\{\emptyset\}),(e_2,\{X\})\}$$

$$A_{E_8}=\{(e_1,\{m\}),(e_2,\{\emptyset\})\}\quad A_{E_{16}}=\{(e_1,\{\emptyset\}),(e_2,\{\emptyset\})\}$$

Consider the soft tritopological spaces $(X,\tau_1,\tau_2,\tau_3,E)$ where $\tau_1=\{\bar{X},\emptyset,A_{E_1},A_{E_4}\}$,$\tau_2=\{\bar{X},\emptyset,A_{E_5},A_{E_{13}}\}$ and $\tau_3=\{\bar{X},\emptyset,A_{E_9}\}$.Then$\tau_{1,2,3}$ open sets= $\{\bar{X},\emptyset,A_{E_1},A_{E_4},A_{E_5}A_{E_9},A_{E_{13}}\}$,

$\tau_{1,2,3}$ Closed sets= $\{\bar{X},\emptyset,A_{E_2},A_{E_6},A_{E_7},A_{E_{10}},A_{E_{14}}\}$,

trio SbO(X)=$\{\bar{X},\emptyset,A_{E_1},A_{E_2},A_{E_3},A_{E_5},A_{E_6},A_{E_7},A_{E_{13}},A_{E_9},A_{E_{15}}\}$,

trio SbC(X)=$\{\bar{X},\emptyset,A_{E_2},A_{E_4},A_{E_6},A_{E_7},A_{E_8},A_{E_5},A_{E_{10}},A_{E_{12}},A_{E_{14}}\}$. Take$\bar{X}=A_{E_4}\cup A_{E_7}$,then trio $sbcl(A_{E_4})=\{(e_1,\{l\}),(e_2,\{\emptyset\})\}=A_{E_4}$,trio $sbcl(A_{E_7})=\{(e_1,\{m\}),(e_2,\{X\})\}=A_{E_7}$. We have trio $sbcl(A_{E_4})\cap A_{E_7}=\emptyset$ and

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trio $sbcl(A_{E_7}) \cap A_{E_4} = \emptyset$ .Therefore A_{E_4} and A_{E_7} are trio separated soft b sets. Hence A_{E_4} and A_{E_7} are trio separation soft b sets of X.

Remark 3.6

From the fact that trio $sbcl(A_E) \subset \tau_{1,2,3} - cl(A_E)$,for every soft subset A_E of X , every trio separated soft set is trio separated soft b set. But the reverse will not be true in the given example.

Example 3.7

Consider the example 3.5. Take $\bar{X} = A_{E_1} \cup A_{E_{12}}$,then $\tau_{1,2,3} - cl(A_{E_4}) = \{(e_1,\{l\}),(e_2,\{m\})\} = A_{E_2}$,$\tau_{1,2,3} - cl(A_{E_7}) = \{(e_1,\{m\}),(e_2,\{X\})\} = A_{E_7}$ .We have $\tau_{1,2,3} - cl(A_{E_4}) \cap A_{E_7} = \{(e_1,\{l\}),(e_2,\{\emptyset\})\} = A_{E_4} \neq \emptyset$ and $A_{E_7} \cap \tau_{1,2,3} - cl(A_{E_4}) = \emptyset$ .Therefore A_{E_4} and A_{E_7} are not trio separated soft sets. Hence A_{E_4} and $A_{E_7}$are not trio separation soft sets of X.

Theorem 3.8

Soft tritopological space is $(X,\tau_1,\tau_2,\tau_3,E)$. Two trio soft b closed sets A_E and G_E are trio separated soft b sets if and only if they are soft disjoint.

Proof: Let $(X,\tau_1,\tau_2,\tau_3,E)$ be soft tritopological space and A_E , G_E be two $(X,\tau_1,\tau_2,\tau_3,E)$ soft b closed sets in X which are $(X,\tau_1,\tau_2,\tau_3,E)$ separated soft b sets. Then by definition 3.3 A_E and G_E are soft disjoint.

Converse: Let A_E and G_E are both soft disjoint and $(X,\tau_1,\tau_2,\tau_3,E)$ soft b closed sets. Then are $(\text{trio } sbcl(A_E)) \cap G_E = A_E \cap (\text{trio } sbcl(G_E)) = \emptyset$ .Therefore A_E and G_E are trio separated soft b sets.

Theorem 3.9

Consider G_E and $H_E$are not empty soft sets of a soft tritopological space $(X,\tau_1,\tau_2,\tau_3,E)$. Consider: If G_E and H_E are trio separated soft b sets , $G_{E_1} \subseteq G_E$ and , $H_{E_1} \subseteq H_E$ then G_{E_1} and H_{E_1} are trio separated soft b sets.

Proof: Let G_E and H_E are trio separated soft b sets. Then trio $sbcl(G_E) \cap H_E = G_E \cap$ trio $sbcl(H_E) = \emptyset$. Since $G_{E_1} \subseteq G_E$, trio $sbcl(G_{E_1}) \subseteq (1,2,3)^* sbcl(G_E)$. Hence $H_{E_1} \cap$ trio $sbcl(G_{E_1}) \subseteq H_E \cap$ trio $sbcl(G_E)$ $=\emptyset$. Similarly $G_{E_1} \cap$ trio $sbcl(H_{E_1}) = \emptyset$ .Thus G_{E_1} and H_{E_1} are trio separated soft b sets.

4.Trio CONNECTED SOFT B SETS

Definition 4.1

Consider $(X,\tau_1,\tau_2,\tau_3,E)$ as a soft tritopological space in which X is called trio connected soft b space then $\bar{X}$ will not be shown as the soft union of two trio separated soft b sets.

Remark 4.2

i) Let soft tritopological space, soft empty set is trivially trio connected soft b set.

ii) Let soft tritopological space, each soft singleton set is trio connected soft b set because it will not be exhibited as a union of two soft not empty trio separated soft b sets.

Theorem 4.3

Soft tritopological space is $(X,\tau_1,\tau_2,\tau_3,E)$. Then the succeeding utterance are same

i) $\bar{X}$ is a trio connected soft b space.

ii) The trio soft b clopen set in X are $\bar{X}$ and $\emptyset$.

iii)$\bar{X}$ will not be indicated as the combination of two disassociate not empty trio soft b open sets.

iv) $\bar{X}$ will not be indicated as the combination of two disassociate not empty trio soft b closed sets.

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Proof: i) → ii) Let $\bar{X}$ is trio connected soft b space. Let A_E be not null actual subset of X.That is trio soft b clopen.Then $\bar{X}\backslash A_E$ is a not empty trio soft b clopen set and $\bar{X} = A_E \cup (\bar{X}\backslash A_E)$. It is a disagreement to $\bar{X}$ is a trio connected soft b space. Hence $\bar{X}$ and $\emptyset$ are the only trio soft b clopen set in X .

ii) → iii) Assume that $\bar{X}$ and $\emptyset$ are the only trio soft b clopen set in X . Suppose (iii) is false. Then $\bar{X} = A_{E_1} \cup A_{E_2}$ where $A_{E_1}$and A_{E_2} are disjoint non empty trio soft b open sets. Then $A_{E_2} = \bar{X}\backslash A_{E_1}$ is trio soft b closed set and not empty. Thus $A_{E_2}$is a not empty actual trio soft b clopen sets in X, which is contradicts (ii)

iii) → iv) Assume $\bar{X}$ will not be indicated as the combination of two disjoint not empty trio soft b open sets. Suppose (iv) false.Then $\bar{X} = A_{E_1} \cup A_{E_2}$ where $A_{E_1}$and A_{E_2} are disassociate not null trio soft b closed sets. Then $A_{E_1} = \bar{X}\backslash A_{E_2}$ and $A_{E_2} = \bar{X}\backslash A_{E_1}$ are disassociate not null trio soft b open sets in X. Thus $\bar{X}$ is the soft combination of two disassociate not null trio soft b open sets. This is contradicts (iii).

iv) → i) Suppose $\bar{X}$ is non trio connected soft b space. Then $\bar{X} = A_{E_1} \cup A_{E_2}$ where $A_{E_1}$and A_{E_2} are disassociate not null trio soft b open sets. Then $A_{E_1} = \bar{X}\backslash A_{E_2}$ and $A_{E_2} = \bar{X}\backslash A_{E_1}$ are disassociate not null trio soft b closed sets in X. This is contradicts (iv).

Proposition 4.4

Every trio connected soft b space is trio connected soft set.

Proof: Let A_E be a trio connected soft b set in the tritopological space $(X, \tau_1, \tau_2, \tau_3, E)$. Then it does not occur a trio separation soft b set of A_E. Since every $\tau_{1,2,3}$ open set is a trio soft b open set , there does non exist a trio separation soft set of A_E . Hence A_E is a trio connected soft set in the soft tritopological space.

Remark 4.5

In the given example, the discourse may not be accurate.

Example 4.6

Trio connected soft set does not imply trio connected soft b set . Let $(X, \tau_1, \tau_2, \tau_3, E)$ be a soft tritopological space, Where X and its soft subsets are considered as in Example 3.5.

$\tau_1 = \{\bar{X}, \emptyset, A_{E_1}, A_{E_4}\}$,$\tau_2 = \{\bar{X}, \emptyset, A_{E_5}, A_{E_{13}}\}$ and $\tau_3 = \{\bar{X}, \emptyset, A_{E_9}\}$.Then $\tau_{1,2,3}$ open sets= $\{\bar{X}, \emptyset, A_{E_1}, A_{E_4}, A_{E_5} A_{E_9}, A_{E_{13}}\}$,$\tau_{1,2,3}$ closed sets= $\{\bar{X}, \emptyset, A_{E_2}, A_{E_6}, A_{E_7}, A_{E_{10}}, A_{E_{14}}\}$,

Since the only trio soft clopen sets are $\emptyset$ and $\bar{X}$, $\bar{X}$ is trio connected soft set. Also

trio SbO(X)=$\{\bar{X}, \emptyset, A_{E_1}, A_{E_2}, A_{E_3}, A_{E_5}, A_{E_6}, A_{E_7}, A_{E_{13}}, A_{E_9}, A_{E_{15}}\}$,

trio SbC(X)=$\{\bar{X}, \emptyset, A_{E_2}, A_{E_4}, A_{E_6}, A_{E_7}, A_{E_8}, A_{E_5}, A_{E_{10}}, A_{E_{12}}, A_{E_{14}}\}$.

Take $\bar{X} = A_{E_4} \cup A_{E_7}$,then trio $sbcl(A_{E_4}) = A_{E_4}$,trio $sbcl(A_{E_7}) = A_{E_7}$and trio $sbcl(A_{E_4}) \cap A_{E_7} = \emptyset$ and trio $sbcl(A_{E_7}) \cap A_{E_4} = \emptyset$. Hence $\bar{X}$ will be demonstrated as a combination of two trio separate soft b sets A_{E_4} and A_{E_7}. Hence $\bar{X}$ is non connected soft b set.

Example 4.6

Trio connectivity soft b set is not a hereditary property.

Consider $(X, \tau_1, \tau_2, \tau_3, E)$ be a soft tritopological space, Where X and its soft subsets are considered as in Example 3.5. Let$\tau_1 = \{\bar{X}, \emptyset, A_{E_4}\}$,$\tau_2 = \{\bar{X}, \emptyset, A_{E_{12}}\}$,$\tau_3 = \{\bar{X}, \emptyset, A_{E_1}\}$. Then $\tau_{1,2,3}$ open sets= $\{\bar{X}, \emptyset, A_{E_1}, A_{E_4}, A_{E_9}, A_{E_{12}}\}$,trio SbO(X)=$\{\bar{X}, \emptyset, A_{E_1}, A_{E_2}, A_{E_3}, A_{E_4}, A_{E_9}, A_{E_{10}}, A_{E_{12}}\}$,

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trio SbC(X)=$\{\bar{X},\emptyset,A_{E_5},A_{E_6},A_{E_7},A_{E_8},A_{E_{13}},A_{E_{14}},A_{E_{15}}\}$.Since the trio soft b clopen set in X are $\bar{X}$ and $\emptyset$, $\bar{X}$ is trio connected soft b set.

Let Y= $\{l\}$,$E=\{e_1,e_2\}$ and $\bar{Y}=\{(e_1,\{l\}),(e_2,\{l\})\}=A_{E_1}$.Consider $\sigma_1=\{\bar{Y},\emptyset,A_{E_4}\}$, $\sigma_2=\{\bar{Y},\emptyset,A_{E_{13}}\}$ and $\sigma_3=\{\bar{Y},\emptyset\}$.Then $\sigma_{1,2,3} open\ set=\{\bar{Y},\emptyset,A_{E_4},A_{E_{13}}\}$. Also $\sigma_{1,2,3}\ clopen\ set=\{\bar{Y},\emptyset,A_{E_4},A_{E_{13}}\}$. Since $A_{E_4},A_{E_{13}}$ are trio soft b clopen sets apart from $\bar{Y}\ and\ \emptyset$, $\bar{Y}$ is non trio connected soft b set.

Proposition 4.7

Let A_E is trio connected soft b set. Let A_{E_1} and A_{E_2} be trio separated soft b sets. If $A_E\subseteq A_{E_1}\cup A_{E_2}$ then either $A_E\subseteq A_{E_1}$ or $A_E\subseteq A_{E_2}$.

Proof: Let A_E be trio connected soft b set. Let A_{E_1} and A_{E_2} be trio separated soft b sets such that $A_E\subseteq A_{E_1}\cup A_{E_2}$. Suppose $A_E\nsubseteq A_{E_1}$ or $A_E\nsubseteq A_{E_2}$. Let $G_E=A_{E_1}\cap A_E\neq\emptyset$ and $H_E=A_{E_2}\cap A_E\neq\emptyset$ then $A_E=G_E\cap H_E$. Since $G_E\subseteq A_{E_1}$, (trio $sbcl(G_E)$) $\subseteq$ trio $sbcl(A_{E_1})$). Also trio $sbcl(A_{E_1})) \cap A_{E_2}=\emptyset$. Then trio $sbcl(G_E))\cap H_E=\emptyset$. Since $H_E\subseteq A_{E_2}$,(trio $sbcl(H_E)$) $\subseteq$ trio $sbcl(A_{E_2})$). Also (trio $sbcl(A_{E_2})) \cap A_{E_1}=\emptyset$ then trio $sbcl(H_E))\cap G_E=\emptyset$. But $A_E=G_E\cap H_E$,therefore A_E be trio connected soft b space. It is a rebut . Then either $A_E\subseteq A_{E_1}$ or $A_E\subseteq A_{E_2}$.

Theorem 4.8

If A_E be trio connected soft b set and $A_E\subseteq G_E\subseteq$ trio $sbcl(A_E)$) then G_E is trio connected soft b set.

Proof: Suppose G_E is non trio connected soft b set then there occur two non empty soft sets A_{E_1} and A_{E_2} such that trio $sbcl(A_{E_1}))\cap A_{E_2}=A_{E_1}\cap$ trio $sbcl(A_{E_2}))=\emptyset$ and $G_E=A_{E_1}\cup A_{E_2}$. Since $A_E\subseteq G_E$ then either $A_E\subseteq A_{E_1}$ or $A_E\subseteq A_{E_2}$. Suppose $A_E\subseteq A_{E_1}$then (trio $sbcl(A_E)$) $\subseteq$ (trio $sbcl(A_{E_1})$) ,thus (trio $sbcl(A_E))\cap A_{E_2}=A_E\cap$ (trio $sbcl(A_{E_2}))=\emptyset$. But $A_{E_2}\subseteq G_E\subseteq$ (trio $sbcl(A_E)$). Thus (trio $sbcl(A_E))\cap A_{E_2}=A_{E_2}$. Therefore $A_{E_2}=\emptyset$,which is a contradiction. If $A_E\subseteq A_{E_2}$, then by the same way we can prove that $A_{E_2}=\emptyset$,it is a rebut. Thus G_E is trio connected soft b set.

Theorem 4.9

If A_E be trio connected soft b set then (trio $sbcl(A_E)$) is trio connected soft b set.

Proof: Assume A_E is trio connected soft b set and (trio $sbcl(A_E)$) is not trio connected soft b set. Then there occur two disjoint not empty trio separated soft b sets A_{E_1} and A_{E_2} by that (trio $sbcl(A_E))=A_{E_1}\cup A_{E_2}$. Since $A_E\subseteq$ (trio $sbcl(A_E)$), $A_E\subseteq A_{E_1}\cup A_{E_2}$. And since A_E be trio connected soft b set , either $A_E\subseteq A_{E_1}$ or $A_E\subseteq A_{E_2}$.

If $A_E\subseteq A_{E_1}$ then (trio $sbcl(A_E)$) $\subseteq$ (trio $sbcl(A_{E_1})$) . But (trio $sbcl(A_{E_1}))\cap A_{E_2}=\emptyset$, hence (trio $sbcl(A_E))\cap A_{E_2}=\emptyset$. Since $A_{E_2}\subseteq$ (trio $sbcl(A_E)$),(trio $sbcl(A_E))\cap A_{E_2}=A_{E_2}$ hence $A_{E_2}=\emptyset$ which is a contradiction.

If $A_E\subseteq A_{E_2}$ we can prove that $A_{E_1}=\emptyset$,which is a rebut. Hence (trio $sbcl(A_E)$) is trio connected soft b set.

CONCLUSION

Soft set theory has a significant role in plays traditional and non- traditional argumentation in study of mathematical application. This paper defined as well as investigated some of the properties of trio separated soft b sets, trio connected soft b sets. The findings in this paper will serve as the basic block for the researchers to apply and develop the future study on soft tritopological spaces.

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