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A STUDY ON SOFT GENERALIZED CONTINUITY IN SOFT BIGENERALIZED TOPOLOGICAL SPACES

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Abstract. The theory of soft set was introduced by Molodtsov [18] in 1999 as a new mathematical tool for deal with uncertainties. The idea of soft topological space was first given by Shabir and Naz in [21]. Later theoretical studies of soft topological spaces have also been researched by some author. Generalized topological spaces are an important generalization of topological spaces. Thomas and John [23] defined soft generalized topological spaces. T.Y.Ozturk et al. [20] initiated the concept of a soft bigeneralized topological spaces and examined its important properties. In this study we consider soft generalized continuity, soft generalized open (closed) mapping and soft generalized homeomorphism on soft bigeneralized topological spaces. We obtained characterizations of these classes of mapping and we established some relationships among these classes.

1. Introduction

The soft set theory, initiated by Russian researcher D. Molodtsov [18], is one of the branches of mathematics, which aims to describe phenomena and concepts of an ambiguous, vague, undefined and imprecise meaning. Also soft set theory is applicable where there is no clearly defined mathematical model. Since soft set theory has a rich potential, researchs on soft set theory and its applications in various fields are progressing rapidly in [14], [15].

The novel of generalized topology goes to back to 1963. Then, N. Levine [13] tried to generalize a topology by replacing open sets with semi-open sets. Later, similiar studies have been done. In the long run in 1997, Á. Császár [3] generalized these new open sets by introduced the concept of $\gamma-$open sets. The theory of generalized topological spaces (briefly GT), introduced by Á. Császár [2], is one of the most important developments of general topology in recent years. Let X be a nonempty set and g be a collection of subsets of X. Then g is called a generalized topology on X and (X, g) is called a generalized topological space, if g satisfies the following two conditions:

(1) $\emptyset \in g$,

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(2) $G_i \in g$ for $i \in I \neq \emptyset$ implies $\underset{i \in I}{\cup} G_i \in g$.

Undoubtedly, generalized topological spaces are an important generalization of topological spaces. Á. Császár defined some basic operators on generalized topological spaces and introduced two kinds of generalized continuity. Especially, generalized continuity admits a characterization furnishing a known characterization of θ-continuous maps. It is observed in the last few years that a large number of papers is devoted to the study of generalized topological spaces. Many topologist have faced generalized topologies. Á. Császár was actively working on this area, despite being approximately at the age of 87. Later, W. K. Min and Y. K. Kim [17] introduced the notion of bigeneralized topological spaces and quasi generalized open sets and study some basic properties for the sets. Later he defined the notion of quasi generalized continuity between bigeneralized topological spaces, and investigated characterizations for the continuity. Let X be a nonempty set and g_1, g_2 be two generalized topologies on X. A triple (X, g_1, g_2) is called a bigeneralized topological space (briefly $BGTS$). In addition to, P.Torton et al. [24] studied some separation axioms in bigeneralized topological spaces.

Topological stuructures of soft set have been studied by some authors in recent years. M. Shabir and M. Naz [21] have initiated the study of soft topological spaces which are defined over an initial universe with a fixed set of parameters and showed that a soft topological space gives a parameterized family of topological spaces. Theoretical studies of soft topological spaces have also been researched by some authors in [1], [4], [5], [7], [16], [19], [22], [25]. As a generalized of soft topological spaces, S.A.El-Sheikh and A.M.Abd-El-Latif [8] introduced the notion of supra soft topological spaces by neglecting only the soft intersection condition. After the concept of bitopological spaces was introduced by J.C. Kelly [11] as an extension of topological spaces in 1963, B.M.Ittanagi [9] defined the notion of soft bitopological space and gave some of types of soft separation axioms. A study of soft bitopological spaces is a generalization of the study of soft topological spaces as every soft bitopological space (X, τ_1, τ_2, E) can be regarded as a soft topological space (X, τ, E) if $\tau_1 = \tau_2 = \tau$.

In later years, many researchers studied bitopological spaces and pair-wise open (closed) sets. Therefore, handling of these spaces in soft concept is important and actual (e.g. [9], [10]).

In 2014, J.Thomas and S.J.John [23] defined basic notions and concepts of soft generalized topological spaces such as soft basis, subspace of soft generalized topoloy. They showed that a soft generalized topology gives a parameterized family of generalized topologies on the initial universe.

It is known that in the topological category, the morphisms between the basic objects, the topological spaces are continuous mappings. Thus any attempt to generalize these important objects must provide a discussion of a property of mappings that corresponds to continuity. Hence we are interested in the adaptation of the change of topology approach from topological topics to aspects of the theory of soft bigeneralized topological spaces. In this study we consider soft generalized continuity, soft generalized open (closed) mapping and soft generalized homeomorphism on soft bigeneralized topological spaces. We obtained characterizations of these classes of mapping and we established some relationships among these classes.

2. PRELIMINARY

In this section we will introduce necessary definitions and theorems for soft sets. Throughout this paper X denotes initial universe, E denotes the set of all parameters, $P(X)$ denotes the power set of X.

Definition 1. [18] *A pair (F,E) is called a soft set over X, where F is a mapping given by $F : E \to P(X)$.*

In other words, the soft set is a parameterized family of subsets of the set X. For $e \in E$, $F(e)$ may be considered as the set of $e-$elements of the soft set (F,E), or as the set of $e-$approximate elements of the soft set, i.e.,

$$(F,E) = \{(e, F(e)) : e \in E,\ F : E \to P(X)\}.$$

After this, $SS(X)_E$ denotes the family of all soft sets over X with a fixed set of parameters E.

Definition 2. [15] *For two soft sets (F,E) and (G,E) over X, (F,E) is called a soft subset of (G,E) if $\forall e \in E$, $F(e) \subseteq G(e)$. This relationship is denoted by $(F,E)\widetilde{\subseteq}(G,E)$.*

Similarly, (F,E) is called a soft superset of (G,E) if (G,E) is a soft subset of (F,E). This relationship is denoted by $(F,E)\widetilde{\supseteq}(G,E)$. Two soft sets (F,E) and (G,E) over X are called soft equal if (F,E) is a soft subset of (G,E) and (G,E) is a soft subset of (F,E).

Definition 3. [15] *The intersection of two soft sets (F,E) and (G,E) over X is the soft set (H,E), where $\forall e \in E$, $H(e) = F(e) \cap G(e)$. This is denoted by $(F,E)\widetilde{\cap}(G,E) = (H,E)$.*

Definition 4. [15] *The union of two soft sets (F,E) and (G,E) over X is the soft set (H,E), where $\forall e \in E$, $H(e) = F(e) \cup G(e)$. This is denoted by $(F,E)\widetilde{\cup}(G,E) = (H,E)$.*

Definition 5. [15] *A soft set (F,E) over X is said to be a null soft set denoted by $(\widetilde{\phi},E)$ if for all $e \in E$, $F(e) = \varnothing$.*

Definition 6. [15] *A soft set (F,E) over X is said to be an absolute soft set denoted by $(\widetilde{X},E)$ if for all $e \in E$, $F(e) = X$.*

Definition 7. [21] *The difference (H,E) of two soft sets (F,E) and (G,E) over X, denoted by $(F,E)\backslash(G,E)$, is defined as $H(e) = F(e)\backslash G(e)$ for all $e \in E$.*

Definition 8. [21] *The complement of a soft set (F,E), denoted by $(F,E)^c$, is defined $(F,E)^c = (F^c,E)$, where $F^c : E \to P(X)$ is a mapping given by $F^c(e) = X\backslash F(e)$, $\forall e \in E$ and F^c is called the soft complement function of F.*

Definition 9. [12] *Let (X,E) and $(Y,E^{'})$ be two soft sets, $f : X \to Y$ and $g : E \to E^{'}$ be two mappings. Then $(f_g) : (X,E) \to (Y,E^{'})$ is called a soft mapping and is defined as: for a soft set (F,A) in (X,E), $(f_g)((F,A)) = f(F)_{g(a)}$, $B = g(A) \subseteq E^{'}$ is a soft set in $(Y,E^{'})$ given by*

$$f(F)(e^{'}) = \begin{cases} f\left(\underset{e \in g^{-1}(e^{'}) \cap A}{\cup} F(e)\right), & \text{if } g^{-1}(e^{'}) \cap A \neq \emptyset, \\ \emptyset, & \text{otherwise,} \end{cases}$$

for $e^{'} \in B \subseteq E^{'}$. $(f(F), g(A))$ is called a soft image of a soft set (F,A).

Definition 10. [12] *Let* (X,E) *and* $(Y,E^{'})$ *be two soft sets,* $(f_g):(X,E)\to(Y,E^{'})$ *be a soft mapping and* $(G,C)\widetilde{\subseteq}(Y,E^{'})$*. Then* $(f_g)^{-1}((G,C)) = f^{-1}(G)_{g^{-1}(C)}$, $D = g^{-1}(C)$*, is a soft set in the soft set* (X,E)*, defined as:*

$$f^{-1}(G)(e) = \begin{cases} f^{-1}\left(G(g(e))\right), & \text{if } g(e)\in C, \\ \emptyset, & \text{otherwise,} \end{cases}$$

for $e\in D\subseteq E$*.* $(f_g)^{-1}((G,C))$ *is called a soft inverse image of* (G,C)*.*

Definition 11. [21] *Let* τ *be the collection of soft sets over* X*, then* $\widetilde{\tau}$ *is said to be a soft topology on* X *if*

1) $(\widetilde{\phi},E),(\widetilde{X},E)$ *belongs to* $\widetilde{\tau}$*;*
2) the union of any number of soft sets in $\widetilde{\tau}$ *belongs to* $\widetilde{\tau}$*;*
3) the intersection of any two soft sets in $\widetilde{\tau}$ *belongs to* $\widetilde{\tau}$*.*

The triplet $(X,\widetilde{\tau},E)$ *is called a soft topological space over* X*. Then members of* $\widetilde{\tau}$ *are said to be a soft open sets in* X*.*

Definition 12. [21] *Let* $(X,\widetilde{\tau},E)$ *be a soft topological space over* X*. A soft set* (F,E) *over* X *is said to be a soft closed set in* X*, if its complement* $(F,E)^c$ *belongs to* $\widetilde{\tau}$*.*

Proposition 1. [21] *Let* $(X,\widetilde{\tau},E)$ *be a soft topological space over* X*. Then the collection* $\widetilde{\tau}_e = \{F(e):(F,E)\in\widetilde{\tau}\}$ *for each* $e\in E$*, defines a topology on* X*.*

Definition 13. [21] *Let* $(X,\widetilde{\tau},E)$ *be a soft topological space over* X *and* (F,E) *be a soft set over* X*. Then the soft closure of* (F,E)*, denoted by* $cl^{s}_{\widetilde{\tau}}(F,E)$*, is the intersection of all soft closed super sets of* (F,E)*. Clearly* $cl^{s}_{\widetilde{\tau}}(F,E)$ *is the smallest soft closed set over* X *which contains* (F,E)*.*

Definition 14. [1] *Let* (F,E) *be a soft set over* X*. The soft set* (F,E) *is called a soft point, denoted by* (x_e,E)*, if for the element* $e\in E$*,* $F(e)=\{x\}$ *and* $F(e^c)=\varnothing$ *for all* $e^c\in E-\{e\}$ *(briefly denoted by* x_e*.)*

It is obvious that each soft set can be expressed as a union of soft points. For this reason, to give the family of all soft sets on X *it is sufficient to give only soft points on* X*.*

Definition 15. [1] *Two soft points* x_e *and* $y_{e'}$ *over a common universe* X*, we say that the soft points are different if* $x\neq y$ *or* $e\neq e'$*.*

Definition 16. [1] *Let* $(X,\widetilde{\tau},E)$ *be a soft topological space over* X*. A soft set* $(F,E)\widetilde{\subseteq}(\widetilde{X},E)$ *is called a soft neighborhood of the soft point* $x_e\widetilde{\in}(F,E)$ *if there exists a soft open set* (G,E) *such that* $x_e\widetilde{\in}(G,E)\widetilde{\subset}(F,E)$*.*

Definition 17. [5] *Let* $(X,\widetilde{\tau},E)$ *and* $(Y,\widetilde{\tau}',E)$ *be two soft topological spaces,* $f:(X,\widetilde{\tau},E)\to(Y,\widetilde{\tau}',E)$ *be a soft mapping. For each soft neighbourhood* (H,E) *of* $(f(x)_e,E)$*, if there exists a soft neighbourhood* (F,E) *of* x_e *such that* $f((F,E))\widetilde{\subset}(H,E)$*, then* f *is said to be a soft continuous mapping at* x_e*.*

If f *is soft continuous mapping for all* x_e*, then* f *is called a soft continuous mapping.*

Definition 18. [23] *Let* $\widetilde{\mu}$ *be the collection of soft set over* X*. Then* $\widetilde{\mu}$ *is said to be a soft generalized topology on* X *if*

(1) $(\widetilde{\phi},E)$ *belongs to* $\widetilde{\mu}$*;*
(2) *the union of any number of soft sets in* $\widetilde{\mu}$ *belongs to* $\widetilde{\mu}$*.*

The triplet $(X, \widetilde{\mu}, E)$ *is called a soft generalized topological space (briefly* $SGT-$*space) over* X.

Definition 19. [20] *Let* $\widetilde{g}_1$ *and* $\widetilde{g}_2$ *be two soft generalized topologies on* X *and* E *be a set of parameters. Then the quadruple system* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *is called a soft bigeneralized topological space (briefly* $SBGT-$*space).*

Proposition 2. [20] *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *be a* $SBGT-$*space. We define*

$$\begin{aligned} \widetilde{g}_{1e} &= \{F(e) : (F, E) \in \widetilde{g}_1\} \\ \widetilde{g}_{2e} &= \{G(e) : (G, E) \in \widetilde{g}_2\}, \end{aligned}$$

for each $e \in E$. *Then* $(X, \widetilde{g}_{1e}, \widetilde{g}_{2e})$ *is a bigeneralized topological space.*

Definition 20. [20] *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *be a* $SBGT-$*space. A soft set* $(F, E) \in SS(X)_E$ *is called a soft* $\widetilde{g}_{1,2}-$*open set if* $(F, E) = (F_1, E)\widetilde{\cup}(F_2, E)$ *where* $(F_1, E) \in \widetilde{g}_1$ *and* $(F_2, E) \in \widetilde{g}_2$.

The complement of soft $\widetilde{g}_{1,2}-$*open set is called a soft* $\widetilde{g}_{1,2}-$*closed set. Clearly, a soft set* (G, E) *over* X *is a soft* $\widetilde{g}_{1,2}-$*closed set in* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *if* $(G, E) = (G_1, E)\widetilde{\cap}(G_2, E)$ *such that* $(G_1, E) \in \widetilde{g}_1^c$ *and* $(G_2, E) \in \widetilde{g}_2^c$, *where*

$$\widetilde{g}_i^c = \{(G, E)^c \in SS(X)_E : (G, E) \in \widetilde{g}_i\}, \; i = 1, 2.$$

Theorem 1. [20] *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *be a* $SBGT-$*space. Then*

(1) $(\widetilde{\phi}, E)$ *is a soft* $\widetilde{g}_{1,2}-$*open set,*
(2) *An arbitrary union of soft* $\widetilde{g}_{1,2}-$*open sets is a soft* $\widetilde{g}_{1,2}-$*open set,*
(3) *An arbitrary intersection of soft* $\widetilde{g}_{1,2}-$*closed sets is a soft* $\widetilde{g}_{1,2}-$*closed set.*

Corollary 1. [20] *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *be a* $SBGT-$*space. Then the family of all soft* $\widetilde{g}_{1,2}-$*open sets is a soft generalized topological space on* X. *This soft generalized topology we denoted by* $\widetilde{g}_{1,2}$, *i.e.,*

$$\widetilde{g}_{1,2} = \left\{(F, E) = (F_1, E)\widetilde{\cup}(F_2, E) : (F_i, E) \in \widetilde{g}_i, \; i = 1, 2\right\}.$$

Theorem 2. [20] *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *be a* $SBGT-$*space. Then,*

(1) *every soft* $\widetilde{g}_i-$*open set is a soft* $\widetilde{g}_{1,2}-$*open set,* $i = 1, 2$,
(2) *every soft* $\widetilde{g}_i-$*closed set is a soft* $\widetilde{g}_{1,2}-$*closed set,* $i = 1, 2$,
(3) *if* $\widetilde{g}_1 \subseteq \widetilde{g}_2$, *then* $\widetilde{g}_{1,2} = \widetilde{g}_2$ *and* $\widetilde{g}_{1,2}^c = \widetilde{g}_2^c$.

Definition 21. [20] *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *be a* $SBGT-$*space and* $(F, E) \in SS(X)_E$. *Then, soft* $\widetilde{g}_{1,2}-$*closure set of* (F, E), *denoted by* $scl_{\widetilde{g}_{1,2}}(F, E)$, *defined by*

$$scl_{\widetilde{g}_{1,2}}(F, E) = \widetilde{\cap}\left\{(G, E) \in \widetilde{g}_{1,2}^c : (F, E)\widetilde{\subseteq}(G, E)\right\}.$$

Note that, $scl_{\widetilde{g}_{1,2}}(F, E)$ *is the smallest soft* $\widetilde{g}_{1,2}-$*closed set that containing* (F, E).

Theorem 3. [20] *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *be a* $SBGT-$*space and* $(F, E) \in SS(X)_E$. *Then,*

$$scl_{\widetilde{g}_{1,2}}(F, E) = scl_{\widetilde{g}_1}(F, E)\widetilde{\cap}scl_{\widetilde{g}_2}(F, E).$$

Definition 22. [20] *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *be a* $SBGT-$*space and* $(F, E) \in SS(X)_E$. *Then soft* $\widetilde{g}_{1,2}-$*interior set of* (F, E), *denoted by* $sint_{\widetilde{g}_{1,2}}(F, E)$, *defined by*

$$sint_{\widetilde{g}_{1,2}}(F, E) = \widetilde{\cup}\left\{(U, E) \in \widetilde{g}_{1,2} : (U, E)\widetilde{\subseteq}(F, E)\right\}.$$

Note that, $sint_{\widetilde{g}_{1,2}}(F, E)$ *is the largest soft* $\widetilde{g}_{1,2}-$*open set contained in* (F, E).

Definition 23. [20] *Let* $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ *be a SBGT−space,* (F,E) *be a soft set over* X *and* $x_e\widetilde{\in}SS(X)_E$. *Then,* (F,E) *is said to be a soft* $\widetilde{g}_{1,2}-$*neighborhood (briefly soft* $\widetilde{g}_{1,2}-nbd$*) of* x_e *if there exists a soft* $\widetilde{g}_{1,2}-$*open set* (G,E) *such that* $x_e\widetilde{\in}(G,E)\widetilde{\subseteq}(F,E)$. *The set of all soft* $\widetilde{g}_{1,2}-nbd$ *of* x_e*, denoted by* $\widetilde{N}_{\widetilde{g}_{1,2}}(x_e)$*, is called family of soft* $\widetilde{g}_{1,2}-nbd$ *of* x_e.

Proposition 3. [20] *Let* $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ *be a SBGT−space,* (F,E) *and* (G,E) *be two soft sets over* X *and* $x_e\widetilde{\in}SS(X)_E$. *Then,*

(1) *If* $(F,E)\in\widetilde{N}_{\widetilde{g}_{1,2}}(x_e)$*, then* $x_e\widetilde{\in}(F,E)$*,*
(2) *If* $(F,E)\in\widetilde{N}_{\widetilde{g}_{1,2}}(x_e)$ *and* $(F,E)\widetilde{\subseteq}(G,E)$*, then* $(G,E)\in\widetilde{N}_{\widetilde{g}_{1,2}}(x_e)$*,*
(3) (F,E) *is a soft* $\widetilde{g}_{1,2}-open$ *set iff* (F,E) *is a soft* $\widetilde{g}_{1,2}-nbd$ *of each its soft points,*
(4) *If* $(F,E)\in\widetilde{N}_{\widetilde{g}_{1,2}}(x_e)$*, then there exists a soft* $\widetilde{g}_{1,2}-open$ *set* (U,E) *such that* $(U,E)\widetilde{\subseteq}(F,E)$ *and* $(U,E)\in\widetilde{N}_{\widetilde{g}_{1,2}}(y_{e'})$ *for every* $y_{e'}\widetilde{\in}(U,E)$.

3. SOFT BIGENERALIZED CONTINUITY

Definition 24. *Let* $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ *and* $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ *be two SBGT−spaces and* $(f,1_E):(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ *(briefly denoted by* f*) be a soft mapping. For each soft* $\widetilde{k}_{1,2}-nbd$ (G,E) *of* $f(x_e)$*, if there exists a soft* $\widetilde{g}_{1,2}-nbd$ (F,E) *of soft point* $x_e\widetilde{\in}SS(X)_E$ *such that* $f((F,E))\widetilde{\subseteq}(G,E)$*, then* f *is said to be soft* $\widetilde{g}_{1,2}-$*continuous mapping at* x_e.

If f *is a soft* $\widetilde{g}_{1,2}-$*continuous mapping for all* $x_e\widetilde{\in}SS(X)_E$*, then* f *is called a soft* $\widetilde{g}_{1,2}-continuous$ *mapping on a soft bigeneralized topological spaces* $(X,\widetilde{g}_1,\widetilde{g}_2,E)$.

Theorem 4. *Let* $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ *and* $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ *be two SBGT−spaces and* $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ *be a soft mapping. Then* f *is a soft* $\widetilde{g}_{1,2}-continuous$ *mapping on a soft bigeneralized topological spaces* $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ *iff* $f^{-1}((G,E))$ *is a soft* $\widetilde{g}_{1,2}-open$ *set, for every soft* $\widetilde{k}_{1,2}-open$ *set* (G,E).

Proof. Suppose that f is a soft $\widetilde{g}_{1,2}-continuous$ mapping on a soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and $(G,E)\in\widetilde{k}_{1,2}$. Let us show that $f^{-1}((G,E))\in\widetilde{g}_{1,2}$. For every soft point $x_e\widetilde{\in}f^{-1}((G,E))$ since $f(x_e)\widetilde{\in}(G,E)$ and f is a soft $\widetilde{g}_{1,2}-continuous$ mapping, then there exists a $\widetilde{g}_{1,2}-nbd$ (F,E) of the soft point x_e such that $f((F,E))\widetilde{\subseteq}(G,E)$. Therefore, $x_e\widetilde{\in}(F,E)\widetilde{\subseteq}f^{-1}((G,E))$. That is, $f^{-1}((G,E))$ is a soft $\widetilde{g}_{1,2}-open$ set.

Conversely, let x_e be a soft point over X and $f(x_e)\widetilde{\in}(G,E)$ be a soft $\widetilde{k}_{1,2}-open$ set in Y. Then $x_e\widetilde{\in}f^{-1}((G,E))$ is a soft $\widetilde{g}_{1,2}-open$ set and $f\left(f^{-1}((G,E))\right)\widetilde{\subseteq}(G,E)$. That is, f is a soft $\widetilde{g}_{1,2}-continuous$ mapping on soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$. □

Theorem 5. *Let* $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ *and* $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ *be two SBGT−spaces and* $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ *be a soft mapping. Then* f *is a soft* $\widetilde{g}_{1,2}-continuous$ *mapping on a soft bigeneralized topological spaces* $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ *iff* $f^{-1}((G,E))$ *is a soft* $\widetilde{g}_{1,2}-closed$ *set in* X *for every soft* $\widetilde{k}_{1,2}-closed$ *set in* Y.

Proof. Let $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be a soft $\widetilde{g}_{1,2}-continuous$ mapping on soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and (G,E) be any soft $\widetilde{k}_{1,2}-closed$ set in Y. Then $(G,E)=(G_1,E)\widetilde{\cap}(G_2,E),(G_i,E)\in\widetilde{k}_i^{\,c}, i=1,2$. Since

$(G,E)^c = (G_1,E)^c \,\widetilde{\cup}\, (G_2,E)^c$ is a soft $\widetilde{k}_{1,2}-open$ set and f is a soft $\widetilde{g}_{1,2}-continuous$ mapping, then

$$\begin{aligned} f^{-1}\left((G,E)^c\right) &= f^{-1}\left((G_1,E)^c \,\widetilde{\cup}\, (G_2,E)^c\right) = f^{-1}\left((G_1,E)^c\right) \widetilde{\cup} f^{-1}\left((G_2,E)^c\right) \\ &= \left(f^{-1}(G_1,E)\right)^c \widetilde{\cup} \left(f^{-1}(G_2,E)\right)^c = \left(f^{-1}(G,E)\right)^c \end{aligned}$$

is obtained. Then $\left(f^{-1}(G,E)\right)^c$ is a soft $\widetilde{g}_{1,2} - open$ set in X. This means that $\left(f^{-1}(G,E)\right)$ is a soft $\widetilde{g}_{1,2} - closed$ set in X.

Conversely, suppose that $f^{-1}((G,E))$ is a soft $\widetilde{g}_{1,2} - closed$ set in X whenever (G,E) is a soft $\widetilde{k}_{1,2}-closed$ set in Y. For any soft $\widetilde{k}_{1,2}-open$ set (H,E) in Y, $(H,E)^c$ is a soft $\widetilde{k}_{1,2} - closed$ set. From the hypothesis, $f^{-1}((H,E)^c)$ is a soft $\widetilde{g}_{1,2} - closed$ set in X. Since $f^{-1}((H,E)^c) = \left(f^{-1}((H,E))\right)^c$ and $\left(f^{-1}((H,E))\right)^c$ is a soft $\widetilde{g}_{1,2} - closed$ in X, then $f^{-1}((H,E))$ is a soft $\widetilde{g}_{1,2} - open$ set in X. Therefore, f is a soft $\widetilde{g}_{1,2} - continuous$ mapping on a soft bigeneralized topological spaces $(X, \widetilde{g}_1, \widetilde{g}_2, E)$. □

Example 1. *Let* $X = \{x^1,\ x^2,\ x^3\}$, $Y = \{y^1,\ y^2,\ y^3\}$ *and* $E = \{e_1,\ e_2\}$. *Then* $\widetilde{g}_1 = \left\{(\widetilde{\phi},E),\ (F_1,E),\ (F_2,E)\right\}$, $\widetilde{g}_2 = \left\{(\widetilde{\phi},E),\ (G_1,E),\ (G_2,E),\ (G_3,E)\right\}$ *are two soft generalized topological spaces over* X *and* $\widetilde{k}_1 = \left\{(\widetilde{\phi},E),\ (H_1,E),\ (H_2,E)\right\}$, $\widetilde{k}_2 = \left\{(\widetilde{\phi},E),\ (S_1,E)\right\}$ *are two soft generalized topological spaces over* Y. *Here the soft sets over* X *and* Y *defined as follows:*

$$\begin{aligned} (F_1,E) &= \left\{(e_1,\ \{x^2,\ x^3\}),\ (e_2,\ \{x^1,\ x^2\})\right\}; \\ (F_2,E) &= \left\{(e_1,\ \{\ x^3\}),\ (e_2,\ \{x^1\})\right\}; \\ (G_1,E) &= \left\{(e_1,\ \{x^1\}),\ (e_2,\ \{x^3\})\right\}; \\ (G_2,E) &= \left\{(e_1,\ \{x^2\}),\ (e_2,\ \{x^1,\ x^2\})\right\}; \\ (G_3,E) &= \left\{(e_1,\ \{x^1,\ x^2\}),\ (e_2,\ X)\right\}; \end{aligned}$$

and

$$\begin{aligned} (H_1,E) &= \left\{(e_1,\ \{y^1,\ y^2\}),\ (e_2,\ \{y^2,\ y^3\})\right\}; \\ (H_2,E) &= \left\{(e_1,\ \{y^2\}),\ (e_2,\ \{y^2\})\right\}; \\ (S_1,E) &= \left\{(e_1,\ \{y^1\}),\ (e_2,\ \{y^2,\ y^3\})\right\}; \end{aligned}$$

Then $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *and* $(Y, \widetilde{k}_1, \widetilde{k}_2, E)$ *are two soft bigeneralized topological spaces where*

$$\widetilde{g}_{1,2} = \left\{ \begin{array}{c} (\widetilde{\phi},E),\ (F_1,E),\ (F_2,E),\ (G_1,E),\ (G_2,E),\ (G_3,E),\ (\widetilde{X},E), \\ (U_1,E) = (F_2,E)\widetilde{\cup}(G_1,E) = \left\{(e_1,\ \{x^1,\ x^3\}),\ (e_2,\ \{x^1,\ x^3\})\right\}, \end{array} \right\}$$

and

$$\widetilde{k}_{1,2} = \left\{(\widetilde{\phi},E),\ (H_1,E),\ (H_2,E),\ (S_1,E)\right\}.$$

If the mapping $f : X \to Y$ *defined as*

$$\begin{array}{cc} e_1 & e_2 \\ f(x^1) = y^2 & f(x^1) = y^3 \\ f(x^2) = y^1 & f(x^2) = y^2 \\ f(x^3) = y^1 & f(x^3) = y^2 \end{array}$$

then f is soft $\widetilde{g}_{1,2}-continuous$ mapping at the soft point $x_{e_1}^1$. However f is not soft $\widetilde{g}_{1,2}-continuous$ mapping on a soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$, since $f^{-1}((H_2,E))\notin\widetilde{g}_{1,2}$.

Theorem 6. *Let $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be two $SBGT-spaces$ and $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be a soft mapping. Then f is soft $\widetilde{g}_{1,2}-continuous$ mapping on a soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ iff $f\left(scl_{\widetilde{g}_{1,2}}(F,E)\right)\widetilde{\subseteq} scl_{\widetilde{k}_{1,2}}(f((F,E)))$.*

Proof. Let f be soft $\widetilde{g}_{1,2}-continuous$ mapping on soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and $(F,E)\in SS(X)_E$ .Since $scl_{\widetilde{g}_{1,2}}(f((F,E)))$ is a soft $\widetilde{k}_{1,2}-closed$ set in Y, $f^{-1}\left(scl_{\widetilde{g}_{1,2}}(f((F,E)))\right)$ is a soft $\widetilde{g}_{1,2}-closed$ set in X. Then

$$scl_{\widetilde{g}_{1,2}}\left(f^{-1}\left(scl_{\widetilde{k}_{1,2}}(f((F,E)))\right)\right)=f^{-1}\left(scl_{\widetilde{k}_{1,2}}(f((F,E)))\right) \quad (4.1)$$

and

$$f((F,E))\widetilde{\subseteq} scl_{\widetilde{k}_{1,2}}(f((F,E))).$$

Thus

$$(F,E)\widetilde{\subseteq} f^{-1}(f((F,E)))\widetilde{\subseteq} f^{-1}\left(scl_{\widetilde{k}_{1,2}}(f((F,E)))\right).$$

From (4.1),

$$scl_{\widetilde{g}_{1,2}}(F,E)\widetilde{\subseteq} scl_{\widetilde{g}_{1,2}}\left(f^{-1}\left(scl_{\widetilde{k}_{1,2}}(f((F,E)))\right)\right)=f^{-1}\left(scl_{\widetilde{k}_{1,2}}(f((F,E)))\right).$$

Hence

$$f\left(scl_{\widetilde{g}_{1,2}}(F,E)\right)\widetilde{\subseteq} scl_{\widetilde{k}_{1,2}}(f((F,E)))$$

is obtained.

Conversely, suppose that $f\left(scl_{\widetilde{g}_{1,2}}(F,E)\right)\widetilde{\subseteq} scl_{\widetilde{k}_{1,2}}(f((F,E)))$ for every $(F,E)\in SS(X)_E$. Let (G,E) be any soft $\widetilde{k}_{1,2}-closed$ set in Y, so $scl_{\widetilde{k}_{1,2}}(G,E)=(G,E)$. From the hypothesis,

$$f\left(scl_{\widetilde{g}_{1,2}}\left(f^{-1}((G,E))\right)\right)\widetilde{\subseteq} scl_{\widetilde{k}_{1,2}}\left(f\left(f^{-1}((G,E))\right)\right)\widetilde{\subseteq} scl_{\widetilde{k}_{1,2}}(G,E)=(G,E)$$

is obtained. Hence

$$scl_{\widetilde{g}_{1,2}}\left(f^{-1}((G,E))\right)\widetilde{\subseteq} f^{-1}((G,E))$$

and

$$f^{-1}((G,E))\widetilde{\subseteq} scl_{\widetilde{g}_{1,2}}\left(f^{-1}((G,E))\right).$$

That is,

$$scl_{\widetilde{g}_{1,2}}\left(f^{-1}((G,E))\right)=f^{-1}((G,E))$$

and, so $f^{-1}((G,E))$ is a soft $\widetilde{g}_{1,2}-closed$ set in X. Thus, f is a soft $\widetilde{g}_{1,2}-continuous$ mapping on soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$. □

Theorem 7. *Let $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be two $SBGT-spaces$, $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be a soft mapping and (G,E) be an arbitrary soft set over Y. If $f^{-1}\left(\left(sint_{\widetilde{k}_{1,2}}(G,E)\right)\right)\widetilde{\subseteq} sint_{\widetilde{g}_{1,2}}\left(f^{-1}((G,E))\right)$ is satisfied, then f is a soft $\widetilde{g}_{1,2}-continuous$ mapping on soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$.*

Proof. Let (G,E) be a soft open set over Y. Then

$$sint_{\widetilde{g}_{1,2}}\left(f^{-1}\left((G,E)\right)\right)\widetilde{\subseteq}f^{-1}\left((G,E)\right)=f^{-1}\left(sint_{\widetilde{k}_{1,2}}(G,E)\right)\widetilde{\subseteq}sint_{\widetilde{g}_{1,2}}\left(f^{-1}\left((G,E)\right)\right)$$

holds. Thus

$$sint_{\widetilde{g}_{1,2}}\left(f^{-1}\left((G,E)\right)\right)=f^{-1}\left((G,E)\right)$$

is obtained. This implies that f is a soft $\widetilde{g}_{1,2}-$*continuous* mapping on a soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$. □

Theorem 8. *If $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ is a soft $\widetilde{g}_{1,2}-$continuous mapping on a soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$, then for each $e\in E$, $f_e:(X,g_{1_e},g_{2_e})\to(Y,k_{1_e},k_{2_e})$ is a bigeneralized continuous mapping.*

Proof. Straightforward. □

Theorem 9. *Let $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be two SBGT$-$spaces, $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be a soft mapping. Then f is a soft $\widetilde{g}_{1,2}-$continuous mapping on a soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ iff $f:(X,\widetilde{g}_1,E)\to(Y,\widetilde{k}_1,E)$ and $f:(X,\widetilde{g}_2,E)\to(Y,\widetilde{k}_2,E)$ are soft $g-$continuous mappings.*

Proof. Let f be a soft $\widetilde{g}_{1,2}-$*continuous* mapping on a soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and (G,E) be a soft $\widetilde{k}_{1,2}-$*open* set over Y. Then there exist $(G_1,E)\in\widetilde{k}_1$ and $(G_2,E)\in\widetilde{k}_2$ such that $(G_1,E)\widetilde{\cup}(G_2,E)=(G,E)$. Since f is a soft $\widetilde{g}_{1,2}-$*continuous* mapping, then

$$f^{-1}\left((G,E)\right)=f^{-1}\left((G_1,E)\widetilde{\cup}(G_2,E)\right)=f^{-1}\left((G_1,E)\right)\widetilde{\cup}f^{-1}\left((G_2,E)\right)$$

is a soft $\widetilde{g}_{1,2}-$*open* set. In this case, $f^{-1}\left((G_1,E)\right)\in\widetilde{g}_1$ and $f^{-1}\left((G_2,E)\right)\in\widetilde{g}_2$. That is, $f:(X,\widetilde{g}_1,E)\to(Y,\widetilde{k}_1,E)$ and $f:(X,\widetilde{g}_2,E)\to(Y,\widetilde{k}_2,E)$ are soft $g-$continuous mappings.

Conversely, suppose that $f:(X,\widetilde{g}_1,E)\to(Y,\widetilde{k}_1,E)$, $f:(X,\widetilde{g}_2,E)\to(Y,\widetilde{k}_2,E)$ are soft $g-$continuous mappings and $(G_1,E)\in\widetilde{k}_1$, $(G_2,E)\in\widetilde{k}_2$. Then there exists a soft $\widetilde{k}_{1,2}-$*open* set (G,E) in $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ such that $(G,E)=(G_1,E)\widetilde{\cup}(G_2,E)$. Since $f:(X,\widetilde{g}_1,E)\to(Y,\widetilde{k}_1,E)$ and $f:(X,\widetilde{g}_2,E)\to(Y,\widetilde{k}_2,E)$ are soft $g-$continuous mappings, then $f^{-1}\left((G_1,E)\right)\in\widetilde{g}_1$ and $f^{-1}\left((G_2,E)\right)\in\widetilde{g}_2$. Therefore, $f^{-1}\left((G_1,E)\right)\widetilde{\cup}f^{-1}\left((G_2,E)\right)=f^{-1}\left((G_1,E)\widetilde{\cup}(G_2,E)\right)=f^{-1}\left((G,E)\right)$. That is, f is a soft $\widetilde{g}_{1,2}-$*continuous* mapping on a soft bigeneralized topological spaces $(X,\widetilde{g}_1,\widetilde{g}_2,E)$. □

Theorem 10. *Let $(X,\widetilde{g}_1,\widetilde{g}_2,E)$, $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ and $(Z,\widetilde{\sigma}_1,\widetilde{\sigma}_2,E)$ be SBGT$-$spaces. If $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ and $g:(Y,\widetilde{k}_1,\widetilde{k}_2,E)\to(Z,\widetilde{\sigma}_1,\widetilde{\sigma}_2,E)$ are soft bigeneralized continuous mappings, then $g\circ f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Z,\widetilde{\sigma}_1,\widetilde{\sigma}_2,E)$ is a soft $\widetilde{g}_{1,2}-$continuous mapping.*

Proof. Straightforward. □

There are a lot of useful mappings defined on generalized topological spaces. Here we generalized the classes of open mappings, closed mappings on a soft bigeneralized topological spaces.

Definition 25. *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *and* $(Y, \widetilde{k}_1, \widetilde{k}_2, E)$ *be two SBGT−spaces,* $f : (X, \widetilde{g}_1, \widetilde{g}_2, E) \to (Y, \widetilde{k}_1, \widetilde{k}_2, E)$ *be a soft mapping. Then,*

- **a:** *f is called a soft $\widetilde{g}_{1,2}$ − open mapping if $f((F,E))$ is a soft $\widetilde{k}_{1,2}$ − open set in $(Y, \widetilde{k}_1, \widetilde{k}_2, E)$ for every soft $\widetilde{g}_{1,2}$ − open set (F,E) in $(X, \widetilde{g}_1, \widetilde{g}_2, E)$;*
- **b:** *f is called a soft $\widetilde{g}_{1,2}$ − closed mapping if $f((K,E))$ is a soft $\widetilde{k}_{1,2}$ − closed set in $(Y, \widetilde{k}_1, \widetilde{k}_2, E)$ for every soft $\widetilde{g}_{1,2}$ − closed set (K,E) in $(X, \widetilde{g}_1, \widetilde{g}_2, E)$.*

Corollary 2. *Notice that the concepts of soft bigeneralized continuous mapping, soft bigeneralized openness and soft bigeneralized closedness are all independent of each other.*

Example 2. *Let* $X = \{x^1,\ x^2\}$, $Y = \{y^1,\ y^2\}$ *and* $E = \{e_1,\ e_2\}$. *Then* $\widetilde{g}_1 = \left\{(\widetilde{\phi}, E),\ (F_1, E)\right\}$, $\widetilde{g}_2 = \left\{(\widetilde{\phi}, E),\ (G_1, E)\right\}$ *are two soft generalized topological spaces over* X *and* $\widetilde{k}_1 = \left\{(\widetilde{\phi}, E),\ (H_1, E)\right\}$, $\widetilde{k}_2 = \left\{(\widetilde{\phi}, E),\ (\widetilde{Y}, E),\ (S_1, E),\ (S_2, E)\right\}$ *are two soft generalized topological spaces over* Y. *Here the soft sets over* X *and* Y *defined as follows:*

$$\begin{aligned}(F_1, E) &= \left\{(e_1,\ \{x^1\}),\ (e_2,\ \{\ x^2\})\right\};\\ (G_1, E) &= \left\{(e_1,\ \{x^1\}),\ (e_2,\ \{x^1,\ x^2\})\right\};\end{aligned}$$

and

$$\begin{aligned}(H_1, E) &= \left\{(e_1,\ \{\ y^2\}),\ (e_2,\ \{y^1\})\right\};\\ (S_1, E) &= \left\{(e_1,\ \{y^2\}),\ (e_2,\ \{y^1,\ y^2\})\right\};\\ (S_2, E) &= \left\{(e_1,\ \{y^1\}),\ (e_2,\ \{y^1\})\right\};\end{aligned}$$

Then $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *and* $(Y, \widetilde{k}_1, \widetilde{k}_2, E)$ *are two soft bigeneralized topological spaces where*

$$\widetilde{g}_{1,2} = \left\{(\widetilde{\phi}, E),\ (F_1, E),\ (G_1, E)\right\}$$

and

$$\widetilde{k}_{1,2} = \left\{ \begin{array}{c} (\widetilde{\phi}, E), (Y, E), (H_1, E), (S_1, E),\ (S_2, E), \\ (U_1, E) = (H_1, E)\widetilde{\cup}(S_2, E) = \{(e_1, \{y_1, y_2\}), (e_2, \{y_1\})\} \end{array} \right\}$$

If the mapping $f : X \to Y$ *is defined as*

$$\begin{array}{cc} e_1 & e_2 \\ f(x^1) = y^2 & f(x^1) = y^2 \\ f(x^2) = y^1 & f(x^2) = y^1, \end{array}$$

then f is a soft $\widetilde{g}_{1,2}$−open and soft $\widetilde{g}_{1,2}$−closed mapping. However f is not a soft $\widetilde{g}_{1,2}$ − continuous mapping on a soft bigeneralized topological spaces $(X, \widetilde{g}_1, \widetilde{g}_2, E)$.

We give the following characterizations of soft bigeneralized openness and soft bigeneralized closedness.

Theorem 11. *Let* $(X, \widetilde{g}_1, \widetilde{g}_2, E)$ *and* $(Y, \widetilde{k}_1, \widetilde{k}_2, E)$ *be two SBGT−spaces,* $f : (X, \widetilde{g}_1, \widetilde{g}_2, E) \to (Y, \widetilde{k}_1, \widetilde{k}_2, E)$ *be a soft mapping. Then,*

- **a:** *f is a soft $\widetilde{g}_{1,2}$ − open mapping iff $f\left(sint_{\widetilde{g}_{1,2}}(F,E)\right) \widetilde{\subseteq} sint_{\widetilde{k}_{1,2}}(f((F,E)))$ for each soft set (F,E) over X.*
- **b:** *f is a soft $\widetilde{g}_{1,2}$ − closed mapping iff $scl_{\widetilde{k}_{1,2}}(f((F,E))) \widetilde{\subseteq} f\left(scl_{\widetilde{g}_{1,2}}(G,E)\right)$ for each soft set (F,E) over X.*

Proof. a: Let f be a soft $\widetilde{g}_{1,2}-open\ mapping$ and $(F,E)\in SS(X)_E$. Then, $sint_{\widetilde{g}_{1,2}}(F,E)$ is a soft $\widetilde{g}_{1,2}-open$ set and $sint_{\widetilde{g}_{1,2}}(F,E)\widetilde{\subseteq}(F,E)$. Since f is a soft $\widetilde{g}_{1,2}-open\ mapping$, $f\left(sint_{\widetilde{g}_{1,2}}(F,E)\right)$ is a soft $\widetilde{k}_{1,2}-open$ set in $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ and $f\left(sint_{\widetilde{g}_{1,2}}(F,E)\right)\widetilde{\subseteq}f((F,E))$. Thus $f\left(sint_{\widetilde{g}_{1,2}}(F,E)\right)\widetilde{\subseteq}\ sint_{\widetilde{k}_{1,2}}(f((F,E)))$ is obtained.

Conversely, suppose that (F,E) is any soft $\widetilde{g}_{1,2}-open$ set in $(X,\widetilde{g}_1,\widetilde{g}_2,E)$. Then $(F,E)=sint_{\widetilde{g}_{1,2}}(F,E)$. From the condition of theorem, we have $f\left(sint_{\widetilde{g}_{1,2}}(F,E)\right)$ $\widetilde{\subseteq}sint_{\widetilde{k}_{1,2}}(f((F,E)))$. Then $f((F,E))=f\left(sint_{\widetilde{g}_{1,2}}(F,E)\right)\widetilde{\subseteq}sint_{\widetilde{k}_{1,2}}(f((F,E)))$ $\widetilde{\subseteq}f((F,E))$.

This implies that $f((F,E))=sint_{\widetilde{k}_{1,2}}(f((F,E)))$. That is, f is a soft $\widetilde{g}_{1,2}-open\ mapping$.

b: Let f be a soft $\widetilde{g}_{1,2}-closed\ mapping$ and $(F,E)\in SS(X)_E$. Since f is a soft $\widetilde{g}_{1,2}-closed\ mapping$, $f\left(scl_{\widetilde{g}_{1,2}}(F,E)\right)$ is a soft $\widetilde{k}_{1,2}-closed$ set in $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ and $f((F,E))\widetilde{\subseteq}f\left(scl_{\widetilde{g}_{1,2}}(F,E)\right)$.Thus $scl_{\widetilde{k}_{1,2}}(f((F,E)))\widetilde{\subseteq}f\left(scl_{\widetilde{g}_{1,2}}(F,E)\right)$ is obtained.

Conversely, suppose that (F,E) is any soft $\widetilde{g}_{1,2}-closed$ set in $(X,\widetilde{g}_1,\widetilde{g}_2,E)$. Then $(F,E)=scl_{\widetilde{g}_{1,2}}(F,E)$. From the condition of theorem,
$scl_{\widetilde{k}_{1,2}}(f((F,E)))\widetilde{\subseteq}f\left(scl_{\widetilde{g}_{1,2}}(F,E)\right)=f((F,E))\widetilde{\subseteq}scl_{\widetilde{k}_{1,2}}(f(F,E))$. This means that $scl_{\widetilde{k}_{1,2}}(f(F,E))=f((F,E))$. That is, f is a soft $\widetilde{g}_{1,2}-closed\ mapping$. □

Proposition 4. *If $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ is a soft $\widetilde{g}_{1,2}-open\ mapping$ (respectively $\widetilde{g}_{1,2}-closed\ mapping$), then for each $e\in E$,*

$$f_e:(X,g_{1_e},g_{2_e})\to(Y,k_{1_e},k_{2_e})$$

is a bigeneralized open (respectively closed) mapping.

Proof. Straghtforward. □

Definition 26. *Let $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be two SBGT−spaces, $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be a soft mapping. Then f is called a soft $\widetilde{g}_{1,2}-homeomorphism$, if*

i: *f is a soft bijection,*
ii: *f is a soft $\widetilde{g}_{1,2}-continuous$,*
iii: *f^{-1} is a soft $\widetilde{g}_{1,2}-continuous\ mapping$.*

Theorem 12. *Let $(X,\widetilde{g}_1,\widetilde{g}_2,E)$ and $(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be two SBGT−spaces, $f:(X,\widetilde{g}_1,\widetilde{g}_2,E)\to(Y,\widetilde{k}_1,\widetilde{k}_2,E)$ be a soft mapping. Then the following conditions are equivalent:*

1) f is a soft $\widetilde{g}_{1,2}-homeomorphism$,
2) f is a soft $\widetilde{g}_{1,2}-continuous$ and soft $\widetilde{g}_{1,2}-closed\ mapping$,
3) f is a soft $\widetilde{g}_{1,2}-continuous$ and soft $\widetilde{g}_{1,2}-open\ mapping$.

Proof. The proofs can be easily obtained by using the previous theorems on continuity, openness and closedness, so are omitted. □

4. **CONCLUSION**

A soft bigeneralized topological spaces is a generalization of the study of bigeneralized topological spaces. In this paper, introducing the concepts of soft continuity, soft openness, soft closedness and soft homeomorphism on a soft bigeneralized topological spaces based on the notions given in [20], furhermore results are given some characterization theorems are obtained, and supported with examples.We hope that our introduced notion and investigation might be a reference for further studies.

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