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On ɳG_Ş-Compactness

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Abstract

Open sets may be viewed as an extension of semi-open sets by applying the notions of semi-open sets and grill nano to nGs-open sets, with the following four goals in mind: The objective is to characterize nGs-open sets by examining and proving numerous of its attributes and comments. And investigate and define new kinds of functions based on the concept of nGs-open sets, using sets of nGs-open sets, we will define a new type of Compact type and call it nGs-open compact then we will find the relationship between these new types of Compact type with nano compact. We will also talk about the relationship between nano grill semi-open sets and continuous functions and the relationship between nano grill semi-open sets and irresolute function as well we give some examples, proofs and observations about the relationship between nano grill semi-open sets and functions and their relation to nano compact.

Keywords: Nano Grill semi-open compact space, ɳG_Ş Ỏ-semi-open compact., nano compact.

1. Introduction

The concept for grill topological spaces rests on the use of two operators: and. The pioneer of this concept was Choquet (1). Some parallels between the Choquat idea and ideas, nets and filters have been discovered. Several hypotheses and characteristics have been discussed in (2–5). It allows for the growth of the topological assembly utilized to account for intangibles like love, intelligence, beauty, instructional quality, etc. Additionally, it broadens the frontiers of Nano topological spaces by employing the concept of grill modifications in the lower approximation, the upper approximation, and the boundary region. First proposed in 1970 by Levine (6), the concept of enlarging closed sets is widely credited as a breakthrough in the field. Lower, higher,

and boundary estimates of a subset of a cosmic set with an important basis to it are the foundation on which the idea of nano topological assemblage rests.
Also, the concept of nano is used to introduce the definitions of the closed set, the interior set, and the closure set. Lellis (7) first developed this concept in 2013. The primary objective of this study is to incorporate a grill into a space containing a generalized closed nano topology. We've established contact with some very important people.

2. Preliminaries

Definition 2.1:(4), (8)

Ꜳ Grill is a nonempty collection of nonempty subsets of a topological space □

i. Ꜳ∈ Ꞡ *and* Ꜳ ⊆ Ɓ ⊆ □ *then* Ɓ ∈ Ꞡ
ii. Ꜳ, Ɓ ⊆ □ *and* Ꜳ ∪ Ɓ ∈ Ꞡ *then* Ꜳ ∈ Ꞡ *or* Ɓ ∈ Ꞡ. (9), (10)

Assuming that □ is a non-empty set, the following sets are grills on □.(11), (12)

- Ø & □(□) \ {Ø} are examples of trivial grills on □.
- $Ꞡ_{\infty}$ is the grill of all infinite subset of □.
- $Ꞡ_{Çȯ}$ is the grill of all uncountable subsets of □.
- $Ꞡ_{□} = \{Ꜳ: Ꜳ \in □(□), □ \in Ꜳ\}$ is a certain point grill on □.
- $Ꞡ_{Ꜳ} = \{Ɓ: Ɓ \in □(□), Ɓ \cap Ꜳ^{Ç} \neq Ø\}$.

∗ If (□, ʈ) is a topological space, and so the set of the all dense subset that does not already exist here is known as G= $\{Ꜳ: iɳʈ(Çl(Ꜳ)) \neq Ǿ\}$ is one kind of grill on □ (4).

∗ Suppose that Ꞡ a grill on (□, ʈ). A mapping ∯:□(□) → □(□) is referred to as ∯(Ꜳ) = { □ ∈ □: Ꜳ ∩ û∈ G for every û ∈ ʈ; □ ∈ û} for every Ꜳ ∈ □(□). A mapping ψ: □(□) →□(□) is referred to as ψ (Ꜳ) = Ꜳ ∪ ∯ (Ꜳ) for every Ꜳ ∈ □(□).(13)

Kuratowski's Axioms of Closure for the map ψ are verified: (13), (14), (15)

i. ψ (Ø) = Ø,
ii. when Ꜳ ⊆ Ɓ, then ψ (Ꜳ) ⊆ ψ (Ɓ),
iii. when Ꜳ ⊆ □, then ψ (ψ (Ꜳ))= ψ (Ꜳ),
iv. when Ꜳ, Ɓ ⊆ □, then ψ (Ꜳ ∪ Ɓ)= ψ (Ꜳ) ∪ ψ (Ɓ).

Definition 2.2: (13)

There exists a special topology $ʈ_{Ꞡ} = \{û \subseteq □: ψ(□ - û) = (□ - û)\}$, when for any Ꜳ ⊆ □ that corresponds inside the topological space, to a grill G (□, ʈ).

ψ (Ꜳ) = Ꜳ ∪ ∯(Ꜳ) = $ʈ_{Ꞡ}$- $Çl$ (Ꜳ) and ʈ ⊆ ʈG.

Remark 2.3: (4)

If Ꞡ = □(□)/{Ǿ}, then ʈG.= ʈ.

Remark 2.4: (2)

We can find $ʈ_{Ꞡ}$ by using the base as follows $\mathcal{B}(ʈ_{Ꞡ}, ʈ) = \{ѵ - Ꜳ; □ \in ʈ, Ꜳ \notin Ꞡ\}$

Definition 2.5:(13)

Let □ ≠ Ǿ and Ɽ be an equivalence relation on □, Ꜳ ⊆ □.

i. The upper approximation of Ꜳ for Ɽ is denoted by $\overline{Ɽ_{□}}(Ꜳ)$, where

$$\overline{Ɽ_{□}}(Ꜳ) = \cup_{□ \in □} \{Ɽ(□): Ɽ(□) \cap Ꜳ \neq Ǿ\}.$$

ii. The lower approximation of A for R is denoted by $\underline{R_{□}}(A)$, where

$$\underline{R_{□}}(A) = \cup_{□\in□} \{R(□): R(□) \subseteq A\}.$$

iii. The boundary region of A for R is denoted by $B_{□}(A)$, where

$$B_{□}(A) = \overline{R_{□}}(A) - \underline{R_{□}}(A).$$

Definition 2.6:(7), (16)

Let $□ \neq \emptyset$ and R be an equivalence relation on □ and $t_{□}(A) = \left\{□, \emptyset, \overline{R_{□}}(A), \underline{R_{□}}(A), B_{□}(A)\right\}$, where $A \subseteq □$. Then $t_{□}(A)$ is a topology on □ named nano topology for A ($□, t_{□}(A)$ space is known as nano topological. The components of $t_{□}(A)$ are named nano-open sets denoted by $\eta - open\ sets$. The complement of a $\eta - open\ sets$ is named a nano-closed set denoted by $\eta - closed\ sets$.

Definition 2.7:(7)

Let $(□, t_{□})$ be N.T.S (nano topological space) and $A \subseteq □$. The nano closure (respectively, nano interior) of A which is short $\eta Çl_{□}(A)$ (respectively, $\eta int_{□}(A)$) is defined by; $\eta Çl_{□}(A) = \cap \{\mathcal{F}, \mathcal{F}^{Ç} \in t_{□}, A \subseteq \mathcal{F}\}$, (resp., $\eta int_{□}(A)) = \eta int_{□}(A) = \{\hat{u}; \hat{u} \in t_{□}, \hat{u} \in A\}$.

Note 8:

We said the triple $(□, t_{□}, G)$ G.N.T.S (Grill nano topological space)..

Definition 2.9:(7)

Let $(□, t_{□})$ be an N.T.S, a subset A of □ is named N.S.O (nano semi-open set) $A \subseteq \eta Çl_{□}(\eta int_{□}(A)) \Leftrightarrow \exists \hat{u} \in t_{□}; \hat{u} \subseteq A \subseteq \eta Çl_{□}(\hat{u})$.

A subset B of □ is called *nano* semi-closed if (□-B) is N.S.O set The collection of all N.S.O (respectively,N.S.C) sets in a nano topological space $(□, t_{□})$.

will be symbolized by $\eta ŞÓ(□)$ (respectively,$\eta G_{Ş}Ç(□)$).

Definition 2.10:(17)

There exists a special topology $\eta t_{□G} = \{\hat{u} \subseteq □: \psi(□ - \hat{u}) = (□ - \hat{u})\}$, when for any $A \subseteq □$ that corresponds to a nano grill G on the topological space $(□, t_{□})$.

$\psi(A) = A \cup \oint(A) = \eta t_{□G}$- $Çl(A)$ and $t_{□} \subseteq \eta t_{□G}$.

Definition 2.11:

Let $(□, t_{□})$ be N.T.S and $A \subseteq □$. The nano closure (respectively, nano interior) of A which is short $\eta Çl_{□}(A)$ (respectively, $\eta int_{□}(A)$) is defined by; $\eta Çl_{□G}(A) = \cap \{\mathcal{F}, \mathcal{F}^{Ç} \in t_{□}, A \subseteq \mathcal{F}\}$, (resp., $\eta int_{□G}(A)) = \eta int_{□G}(A) = \{\hat{u}; \hat{u} \in t_{□}, \hat{u} \in A\}$.

Definition 2.12: (18), (19), (20)

A topological spaces $(□, t_{□}, G)$ is named nano compact space if and only if all nano open cover of □ has a finite subcover..

3. Nano Grill semi-open sets in nano compact space

Definition 3.1:

For any Grill topological space $(□, t_{G})$ and $A \sqsubseteq □$; A is said to be nano Grill semi-open if there exists $\hat{u} \in t_{□}$; $\hat{u} - A \notin G$ and $A - \eta Çl_{□G}(\hat{u}) \notin G$ .And A denoted by $\eta G_{Ş}$-open. $□ - A$ is a nano Grill semi-closed and denoted by $\eta G_{Ş}$ -semi-closed and the set of all $\eta G_{Ş}$ -open presently by

$\eta Ꞡ_{Ş}\dot{O}$ ($\square$) and the set of all $\eta Ꞡ_{Ş}$-semi-closed presently by $\eta Ꞡ_{Ş}Ç(\square)$.

Example 3.2:

Let ($\square$, $ƫ_{\square}$, Ꞡ) be a nano grill topological space to be a nano grill and

$$\square=\{\square_1, \square_2, \square_3, \square_4\}$$

$$Ꞡ = \{\hat{u} \sqsubseteq \square; \square_2 \in \hat{u}\}$$

$$Ꞡ = \{\{\square_2\}, \{\square_1, \square_2\}, \{\square_3, \square_2\}, \{\square_4, \square_2\}, \{\square_1, \square_2, \square_3\}, \{\square_1, \square_2, \square_4\}, \{\square_2, \square_3, \square_4\}, \square\}$$

$$Ʀ=\{(\square_1, \square_1), (\square_2, \square_2), (\square_3, \square_3), (\square_4, \square_4), (\square_2, \square_4), (\square_4, \square_2)\}$$

$$Ʀ \setminus [\square] = \{\{\square_1\}, \{\square_2, \square_4\}, \{\square_3\}$$

$$\square \sqsubseteq \square, \square = \{2,3\},$$

$$ƫ_{\square} = \{\square, \acute{\emptyset}, \{3\}, \{2,4\}, \{2,3,4\}\}$$

$$\mathcal{B} = \{\square - Ⱥ; \square \in ƫ_{\square} \wedge Ⱥ \notin Ꞡ\}$$

$$\mathcal{B} = \left\{\square, \acute{\emptyset}, \{\square_1, \square_2, \square_4\}, \{\square_1, \square_2, \square_3\}, \{\square_2, \square_3, \square_4\}, \{\square_2, \square_3\}, \{\square_2, \square_4\}, \{\square_1, \square_2\}, \{\square_2\}, \{\square_3\}\right\}$$

$$= ƫ_{\square Ꞡ}$$

$$\therefore \eta Ꞡ_{Ş}\dot{O}(\square) = \square(\square) .$$

Proposition 3.3:

i. Every nano open set is a $\eta Ꞡ_{Ş}$ -open sets.
ii. Every nano closed set is a $\eta Ꞡ_{Ş}$ -closed.

Example 3.2 demonstrates that the converse of Remark 3.3(i)(ii) is not true.

Definition 3.4:

Let ($\square$,$ƫ_{\square}$, Ꞡ) be a nano gr$i$ll topological space. By a $\eta Ꞡ_{Ş} - open\ cover\ of$ $\square$ we mean a subfamily of $\eta Ꞡ_{Ş}\dot{O}(\square)$ wich cover $\square$

Definition 3.5:

A nano grill topological space ($\square$, $ƫ_{\square}$, Ꞡ) is said to be $\eta Ꞡ_{Ş} - compact\ space$if every $\eta Ꞡ_{Ş} - open\ cover$ for $\square$ has a finite subcover.

Theorem3.6:

A nano grill topological space ($\square$, $ƫ_{\square}$, Ꞡ) is be $\eta Ꞡ_{Ş} - compact\ space$ if and only if every family of $\eta Ꞡ_{Ş} - closed\ subsets$ of $\square$ with finite intersection property has a non-empty intersection.

Proof:

Suppose that $\square$ is $\eta Ꞡ_{Ş} - compact\ space$ and let $\{Ғ_i: i \in \Lambda\}$ be a family of $\eta Ꞡ_{Ş} - closed\ subsets$ of $\square$ with (F.I.P). Assume that $\cap_{i\in\Lambda} Ғ_i = \emptyset$, then $\cup_{i\in\Lambda} {Ғ^c}_i = \square$, where $\{{Ғ^c}_i: i \in \Lambda\}$ is a $\eta Ꞡ_{Ş} - open\ cover$of $\square$ which is a $\eta Ꞡ_{Ş} - compact\ space$, If follows that there exists a finite subcover $\{{Ғ^c}_i\}^n{}_{i=1}$ such that $\square = \cup_{i=1}^{n} {Ғ^c}_i$, then $\cup_{i=1}^{n} Ғ_i = \emptyset$ which is a contradiction. Since$Ғ_i: i \in \Lambda\}$hasaF.I.P. Now, suppose that every family of $\eta Ꞡ_{Ş} - closed\ subsets$ of $\square$ with (f.i.p) has a non-empty intersection. Assume that $\square$ is not $\eta Ꞡ_{Ş} - compact\ space$, let $\{u_\alpha: \alpha \in \Lambda\}$ be a $\eta Ꞡ_{Ş} - open\ cover$of $\square$ and suppose if possible, $\{u_\alpha: \alpha \in \Lambda\}$ has no finite subcover. The collection $\{u^c{}_\alpha : \alpha \in \Lambda\}$ has the F.I.P, if but $\{u^c{}_\alpha : \alpha \in \Lambda\}$ is a family of ηG̶Ş $-$ *closed sets*, so $\cap_{\alpha\in\Lambda} u^c{}_\alpha \neq \emptyset$, it follows that $\cup_{\alpha\in\Lambda} u_\alpha \neq$ □ which is contradiction since $\{u_\alpha : \alpha \in \Lambda\}$ is a ηG̶Ş $-$ *open cover* of □ .

Theorem 3.7:

Every ηG̶Ş $-$ *compact space* is a nano compact space.

Proof:

Let $U = \{u_{\mathrm{i}}, \mathrm{i} \in \Lambda; u_{\mathrm{i}} \in$ ƫ▯ $\forall$ i $\}$ is an open cover for □ such that □ $= \bigcup_{\mathrm{i}\in\Lambda} u_{\mathrm{i}}$ and since every open set is a ηG̶Ş $-$ open sets .So, U is a ηG̶Ş $-$ *open cover* for □ , and since Ӽ is a not ηG̶Ş $-$ *compact* set .So, there exist a finite subcover say $U = \{u_1, u_2, \dots, u_n\}$ such that □ $= \bigcup_{\mathrm{i}=1}^{n} u_{\mathrm{i}}$ .Therefore, □ is a nano compact space.

Definition 3.8:

Let $\mathcal{F}$: (□, ƫ▯, G̶) $\to$ (Y, ƫ▯′, G̶′) be a function then $\mathcal{F}$ believed to be;

1. ηG̶ *semi* $-$continuous function, denoted by ηG̶Ş-continuous function if $\mathcal{F}^{-1}$(u) $\in$ ηG̶ŞȎ(□)for all u $\in$ ƫ▯.
2. Strongly ηG̶ *semi* $-$continuous function, denoted by". *Strongly* ηG̶Ş-continuous function " *if* $\mathcal{F}^{-1}$(u) $\in$ ƫ▯, fore all u $\in$ ηG̶ŞȎ(Y) .
3. ηG̶ *semi*-irresolute function, denoted by ηG̶Ş -irresolute function if $\mathcal{F}^{-1}$(u) $\in$ ηG̶ŞȎ(□), for all u $\in$ ηG̶ŞȎ(Y).

Proposition 3.9:

Let $\mathcal{F}$: (□, ƫ▯, G̶) $\to$ (Y, ƫ▯′, G̶′) be a function.

1. $\mathcal{F}$ is ηG̶Ş -irresolute function whenever $\mathcal{F}$ is strongly ηG̶Ş-continuous function.
2. If $\mathcal{F}$ is a strongly ηG̶Ş-continuous function then $\mathcal{F}$ is a continuous function.
3. " *When* $\mathcal{F}$ *is a continuous function* " then $\mathcal{F}$isηG̶Ş-continuous function.
4. $\mathcal{F}$ isηG̶Ş-continuous function whenever $\mathscr{F}$ is a ηG̶Ş -irresolute function.

In general, the opposite of (proposition 3.9) is not supported by the following examples.

Example 3.10:

Let $\mathcal{F}$: (□, ƫ▯, G̶) $\to$ (□, ƫ▯, G̶~) be a function such that $\mathcal{F}$(□) = □ for each □ $\in$ □

Where

$$□ = \{Ӽ_1, Ӽ_2, Ӽ_3\}, G̶ = □(□) \setminus \{\acute{\emptyset}\}$$

$$Ʀ = \{(□_1, □_1), (□_2, □_2), (□_3, □_3), (□_2, □_3), (□_3, □_2)\}$$

$$Ʀ \setminus [□] = \{\{□_2, □_3\}, \{□_1\}\}, ▯ = \{□_1\}$$

$$ƫ▯ = \left\{□, \acute{\emptyset}, \{□_1\}\right\}$$

$$G̶^{\sim} = \{u; □_1 \in u\}, ηG̶ŞȎ(□) = \{u; □_1 \in u\} \cup \{\emptyset\}, ηG̶^{\sim}_ŞȎ(□) = □(□) .$$

So that,,$\mathcal{F}$ isηG̶Ş-continuous function and continuous function but it's not ηG̶Ş -irresolute function and it's not strongly ηG̶Ş-continuous function.

Example 3.11:

The function $\mathcal{F}$: (□, ƫ▯, G̶) $\to$ (□, ƫ▯, G̶~) such that

$$\mathcal{F}(\{□_2\}) = \{□_1\}, \mathcal{F}(\{□_1\}) = \{□_2\}, \mathcal{F}(\{□_3\}) = \{□_3\},$$

Where

$$□ = \{□_1, □_2, □_3\}, Ꞡ^{\sim} = □(□) \setminus \{\acute{Ø}\}\}$$

$$Ꞧ = \{(□_1, □_1), (□_2, □_2), (□_3, □_3), (□_2, □_3), (□_3, □_2)\}$$

$$Ꞧ \setminus [□] = \{\{□_2, □_3\}, \{□_1\}\}, □ = \{□_1\}$$

$$ŧ_{□} = \left\{□, \acute{Ø}, \{□_1\}\right\},$$

$$Ꞡ = \{u; □_1 \in u\}, ηꞠ_Ş\dot{O}(□) = □(□) \setminus \{\acute{Ø}\},$$

$ηꞠ_Ş\dot{O}(□) = \{u; □_1 \in u\} \cup \{Ø\}, \mathcal{F}\ is\ ηꞠ_Ş\dot{O}(□)$ continuous function and $ηꞠ_Ş$ -irresolute function but it isn't continuous function and not strongly $ηꞠ_Ş$-continuous function it's not since

$$\mathcal{F}^{-1}(□_1) = \{□_2\} \notin ŧ_{□}.$$

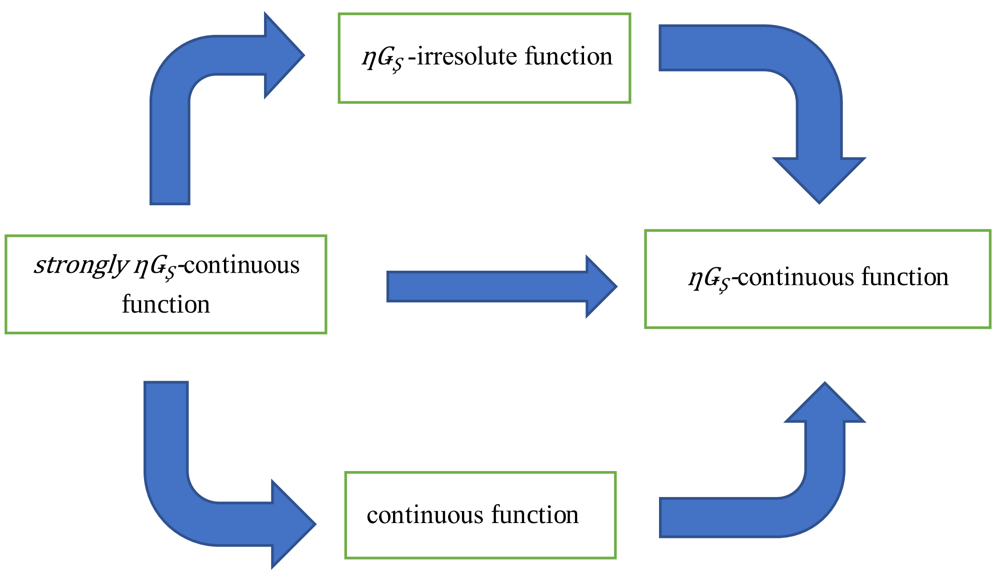

Diagram1. Continuous functions via $ηꞠ_Ş$- open

Proposition 12:

i. The $ηꞠ_Ş$- irresolute image function $ηꞠ_Ş - compact\ space$is a $ηꞠ_Ş - compact\ space.$

ii. In strongly $ηꞠ_Ş$ − continuous the image of nano compact space is a $ηꞠ_Ş - compact\ space.$

iii. The $ηꞠ_Ş$ − continuous function the image function of $ηꞠ_Ş - compact$ is a nano compact.

Proposition 3.13:

A $ηꞠ_Ş - closed\ subsets$ of $ηꞠ_Ş - compact\ space$ is $ηꞠ_Ş - compact.$

Theorem 3.14:

If A & B are $ηꞠ_Ş - compact$, then A∪ B is a $ηꞠ_Ş - compact.$

Proposition 3.15:

Every $ηꞠ_Ş - compact$ is a nano compact.

Example 3.16:

Let (Ʀ̃, □, ƫ_?) be any nano topological space such that Ʀ̃ is the set of all real numbers and Ʀ = {(r,r), r ∈ ?} so, Ʀ \ $[r]$ = {{r}, r ∈ ?}. Now, if w= {1} and G = □[?] \ Ø, then $\overline{Ʀ_?} = \{1\} = \underline{Ʀ_?}$ *and* $Ƀ_? = Ø$ so, $ƫ_? = ηƫ_{?G} = \{?, Ø, \{1\}\}$ and ηG$_Ş$Ọ̉(?) = {û⊆ ?; 1 ∈ û} ∪ Ø .This much is clear: (Ʀ̃, ƫ_?, G) is a nano compact which is not ηG$_Ş$ − *compact* since L = {{1,r}, r ∈ ?} is ηG$_Ş$ − *open cover* has no finite subcover.

4. Conclusion

In this work, a new type of open set was studied using the concept of nano-topology ,grill and nano compact which is called ηG$_Ş$ − *open sets*. The properties of this set were studied. It was found that ηG$_Ş$Ọ̉(□) represents a supra-topology space. New forms of functionality were defined by applying this notion, and the relationship between these functions was found.

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Conflict of Interest

There are no conflicts of interest.

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