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Fibrewise micro-connected topological spaces

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Abstract

Fibrewise topological spaces theory be a new branch of mathematics, emerging from algebraic topology. It's a tool that was essential to homotopy theory. The idea of fibrewise topological spaces is widely used in a wide range of mathematical disciplines, such as groups, differential geometry, and dynamical systems theory. The study of fibrewise topological spaces includes connectivity as one of its key notions. Regarding this, we of the current study construct the concept from fibrewise micro connected topological spaces and explore their main conclusions. Also, the objectives of this article are to define the micro hyperspace, micro ultra-connected and extremally dis connected to investigate its properties. functions that maintain the micro connectivity feature were developed and a characterization of the connected in fibrewise topological space was presented.

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1. Introduction

The theory of fibrewise topological spaces has recently drawn the attention of several scholars, including Hussain and Ghafil [10]. Connectivity, on the other hand, is one of the primary elements that are regarded to be part of in general topology and has been researched via several researchers, including

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Mohammed [10], Dasgupta and Chakrabarti [11]. As a beginning point in the fibrewise categorization, which be indicated via the symbol (Ƒ.ƓƊ.), sets across provided set known the fundamental set. If Ḃ indicates the fundamental set, thereafter Ƒ.ƓƊ. set over Ḃ includes from set Ɲ, and the function $\wp$: Ɲ →Ḃ known as a projection. At every points b from Ḃ, a fibre over b is subsets $Ɲ_b = \wp^{-1}(b)$ from Ɲ. As surjectivity be not necessary, fibers might be empty, thus for any subsets Ḃ* for Ḃ we regard $Ɲ_{Ḃ^*} = \wp^{-1}(Ḃ^*)$, or in the other words $Ɲ_{Ḃ^*} = \wp^{-1}(Ḃ\ ^*)$ = Ɲ|Ḃ* being a Ƒ.ƓƊ. sets over Ḃ* with determine as a projection via $\wp$.[1], [2]

We will delve into interconnected fibrewise topological spaces in the topic of communication with fibrewise topologies, which also contains preliminary research results.

Definition 1.1: [3] If $\mathcal{H}$, and $\mathcal{Y}$ are Ƒ.ƓƊ sets, with the projections $\wp_{\mathcal{H}}: \mathcal{H} \to$ Ḃ, and $\wp_{\mathcal{Y}}: \mathcal{Y} \to$ Ḃ, a function φ: $\mathcal{H} \to \mathcal{Y}$ be stated to be Ƒ.ƓƊ. if $\wp_{\mathcal{Y}}$ o φ = $\wp_{\mathcal{H}}$ for each point b of Ḃ . In other terms if $\varphi(\mathcal{H}_b) \subset \mathcal{Y}_b$ for each point b from Ḃ.

It has been noted that Ƒ.ƓƊ. function φ: $\mathcal{H} \to \mathcal{Y}$ over Ḃ determined via restriction, the Ƒ.ƓƊ. function $\varphi_{Ḃ^*}: \mathcal{H}_{Ḃ^*} \to \mathcal{Y}_{Ḃ^*}$ over Ḃ*, ∀Ḃ* from Ḃ.

Definition 1.2: [4] Consider this Ḃ is topological spaces; and Ƒ.ƓƊ. topology on Ƒ.ƓƊ. set Ɲ over Ḃ, with the intention from all topology on Ɲ at as projections $\wp$ is continuous.

Definition 1.3: [5] A Ƒ.ƓƊ. functions φ: $\mathcal{H} \to \mathcal{Y}$ when $\mathcal{H}$ and $\mathcal{Y}$ are Ƒ.ƓƊ.Ƭ.ς over Ḃ, recognized as:

I. Continuous where at every point h ∈ $\mathcal{H}_b$ when b ∈ Ḃ, reverse images from any open sets from φ(h) be open sets from h.
II. Open if, a direct image from all open set from h be open set from φ(h), at any element h ∈ $\mathcal{H}_b$, when b ∈ Ḃ.
III. Closed if, a direct image from all closed set from h be closed set from φ(h), at any point h ∈ $\mathcal{H}_b$, when b ∈ Ḃ.

Definition 1.4: [6][7] Suppose that Ư a ɱ.Ƭ.ς, a set $\mathcal{X}$ ⊆ Ư be ɱ.closure is indicated via the symbol ɱ.ȼḽ($\mathcal{X}$), which be defined as ɱ.ȼḽ($\mathcal{X}$) = ∩{ $\mathcal{Y}$; $\mathcal{Y}$ be ɱ.closed in Ư, and $\mathcal{X} \subseteq \mathcal{Y}$ }.

A set $\mathcal{X}$ ⊆ Ư be ɱ. interior is indicated via the notation ɱ.ịṇṭ($\mathcal{X}$), which has the definition ɱ.ịṇṭ($\mathcal{X}$) = ∪{Ʊ: Ʊ be ɱ.open in Ư and Ʊ ⊆ $\mathcal{X}$}.

Definition 1.5: [8] Consider (Ư, $\mathcal{T}$) be a topological space be stated to have a connected space if Ư cannot write or union from two non.empty disjoint open sets, decomposed.

Viz: Ư be connected iff Ư ≠ Å ∪ ß; Å ≠ ∅ ≠ ß, Å ∩ ß ≠ ∅; Å, ß ∈ $\mathcal{T}$.

Ư be disconnected iff Ư = Å ∪ ß; Å ≠ ∅ ≠ ß, Å ∩ ß ≠ ∅; Å, ß ∈ $\mathcal{T}$.

Definition 1.6: [9] Assume that Ư be a topological space, be known as hyper connected if each non.empty intersection from two open sets be not empty.

Definition 1.7: [10] if Ư is topological spaces, be known as ultra-connected if each non.empty intersection from two closed sets be not empty.

Definition 1.8: [11][12] Assume that Ư be a topological space, be known as extremally dis connected if a closure from each open set continues to an open set in Ư

2. Fibrewise Micro-Connected Topological Spaces

In this sense, the focus of the current section is on defining connectedness on fibrewise micro topological spaces and examining their characteristics.

Definition 2.1: If Ɲ is Ƒ.ƓƆ.ɱ.Ʈ.ς over Ḃ, be known as Ƒ.ƓƆ.ɱ. connected which be represented via the symbol (Ƒ.ƓƆ.ɱ.₡), if for any two point u, v ∈ $Ɲ_b$ when b ∈ Ḃ will not be the union of two disjoint non.empty ɱ.open sets Ʊ, and ϑ from Ɲ, when u ∈ Ʊ, and v ∈ ϑ. On the other hand, be referred to as a Ƒ.ƓƆ.ɱ.disconnected which be represented via the symbol (Ƒ.ƓƆ.ɱ.dis.₡).

The example below be given to help understanding this term better.

Example 2.2: Consider Ư = {r, j, k, w}, Ư/Ʀ = {{r}, {k}, {j, w}}, $\mathcal{H}$ = {j, w} ⊆ Ư. The $\mathcal{T}_Ʀ(\mathcal{H})$ = {Ư, {j, w}, ∅}, thereafter ɱ = {r} ∉ $\mathcal{T}_Ʀ(\mathcal{H})$. Then $ɱ_Ʀ(\mathcal{H})$ = {∅, {r}, {j, w}, {r, j, w}, Ư}. Let Ḃ = {q, s, t, p}, Ḃ/Ʀ = {{q}, {t}, {s, p}}, ϑ = {s, p} ⊆ Ḃ, then $\acute{\mathcal{T}}_Ʀ(\vartheta)$ = {Ḃ, {s, p}, ∅}, then ɱ́ = {q} ∉ $\acute{\mathcal{T}}_Ʀ(\vartheta)$. Then $ɱ́_Ʀ(\vartheta)$ = {Ḃ, {q}, {s, p}, {q, s, p}, ∅}. Define a projection ℘: Ư→ Ḃ; ℘(r) = q, ℘(j) = s, ℘(w) = P, ℘(k) = t. Take note of the fact that, any ɱ.open set $\mathcal{D}$ of Ḃ, $℘^{-1}(\mathcal{D})$ a ɱ.open sets in Ư, thereafter ℘ is ɱ. continuous. In contrast Ư be Ƒ.ƓƆ.ɱ.₡.Ʈ.ς, because, the point q and s ∈ Ḃ; r ∈{r} say Ʊ, j ∈ {j, w}say ϑ of Ư, and Ʊ ∪ ϑ ≠ Ư, Ʊ ∩ ϑ = ∅, and Ʊ ≠ ∅ ≠ ϑ.

Example 2.3: Assume that Ư = {1, 2, 3, 4}, Ư/Ʀ = {{3, 4},{1},{2}}, $\mathcal{H}$ = {1, 3} ⊆ Ư. The $\mathcal{T}_Ʀ(\mathcal{H})$ = {Ư, ∅, {1, 3, 4}, {3, 4}}, then ɱ = {2} ∉ $\mathcal{T}_Ʀ(\mathcal{H})$. Afterward $ɱ_Ʀ(\mathcal{H})$ = {Ư, ∅, {1}, {2}, {3, 4}, {1, 2}, {1, 3, 4}, {2, 3, 4}}. Let Ḃ = {a, b, c, d}, Ḃ/Ʀ = {{c, d}, {a}, {b}}, ϑ = {a, c} ⊆ Ḃ, then $\acute{\mathcal{T}}_Ʀ(\vartheta)$ = {Ḃ, ∅, {a}, {c, d}, {a, c, d}}, then ɱ́ ={b}∉ $\acute{\mathcal{T}}_Ʀ(\vartheta)$. Then $ɱ́_Ʀ(\vartheta)$ = {Ḃ, ∅, {b}, {a}, {a, b}, {c, d}, {a, c, d}, {b, c, d}}. Define a projection ℘: Ư→ Ḃ such that ℘ (1) = a, ℘(2) = b, ℘(3) = d, ℘(4) = c. Take note of the fact that, any ɱ.open set $\mathcal{D}$ in Ḃ, $℘^{-1}(\mathcal{D})$ a ɱ.open sets of Ư, thereafter ℘ is ɱ. continuous. In contrast Ư be Ƒ.ƓƆ.ɱ.dis.₡.Ʈ.ς, because the point a and b ∈ Ḃ; 1 ∈ {1, 3} say Ʊ, 2 ∈ {2, 4} say ϑ of Ư, and Ʊ ∪ ϑ = Ư, Ʊ ∩ ϑ = ∅, and Ʊ ≠ ∅ ≠ ϑ.

The following proposition demonstrates how a quality known as Ƒ.ƓƆ.ɱ.₡ be one that is preserved via a Ƒ.ƓƆ.ɱ. continuous function.

Proposition 2.4: Assume that Ɲ be Ƒ.ƜƆ.ɱ.₡, thereafter the following assumptions are equivalent:

I. Ɲ be Ƒ.ƜƆ.ɱ.₡.Ʈ.ς over Ḃ.

II. Ɲ ≠ $'E_1 \cup 'E_2$, and $'E_1$, $'E_2$ are non. empty ɱ. closed, disjoint subsets from Ɲ, when $e_1 \in 'E_1$, $e_2 \in 'E_2$ for any $e_1, e_2 \in$ $Ɲ_b$

III. Only Ɲ and ∅ are the ɱ. open and ɱ. closed subsets from Ɲ.

IV. If 'E be any proper; 'E ⊂ Ɲ; ∅ ≠ 'E ⊂ Ɲ, and $e_1 \in 'E$, and $e_2 \in 'E^c$ for any $e_1, e_2 \in$ $Ɲ_b$, thereafter β('E) ≠ ∅.

3. Fibrewise Micro-Hyper connected and Micro-Ultra connected Topological spaces

This section, studied micro-hyper connected and micro-ultra connected in a Ƒ.ƜƆ.ɱ.Ʈ.ς, the properties of each of them, interrelationships, implications and the observations to serve our study in this paper.

Definition 3.1: Assum that Ɲ be a Ƒ.ƜƆ.ɱ.Ʈ.ς over Ḃ, be known as Ƒ.ƜƆ.ɱ. hyper connected which be represented via the symbol (Ƒ.ƜƆ.ɱ.Ҍ.₡), if for any two point u, v ∈ $Ɲ_b$, when b ∈ Ḃ will be the intersection of two disjoint non.empty ɱ.open sets Ʊ, and ϑ from Ɲ when u ∈ Ʊ, and v ∈ ϑ be not empty, otherwise it is not Ƒ.ƜƆ.ɱ.Ҍ.₡.

The example below be given to help understanding this term better.

Example 3.2. Consider Ư = {r, j, k}, Ư/Ʀ = {{j, k}, {r}}, $\mathcal{H}$ = {r} ⊆ Ư. The $\mathcal{T}_Ʀ(\mathcal{H})$ = {Ư, {r}, ∅}, thereafter ɱ = {r, j} ∉ $\mathcal{T}_Ʀ(\mathcal{H})$. Then $ɱ_Ʀ(\mathcal{H})$ = {∅, {r}, {r, j}, Ư}. Let Ḃ = {q, s, t}, Ḃ/Ʀ = {{q}, {s, t}}, ϑ = {q} ⊆ Ḃ, then $\acute{\mathcal{T}}_Ʀ(\vartheta)$ = {Ḃ, ∅, {q}}, then ɱ́ = {q, s} ∉ $\acute{\mathcal{T}}_Ʀ(\vartheta)$. Then $ɱ́_Ʀ(\vartheta)$ = {Ḃ, {q, s}, {q}, ∅}. Define a projection ℘: Ư→ Ḃ; ℘(r) = ℘(j) = q, ℘(k) = t. In contrast Ư be Ƒ.ƜƆ.ɱ.Ҍ.₡.Ʈ.ς, because, the point q and t ∈ Ḃ; ∃two disjoint nonempty ɱ.open set Ʊ = {r}, & ϑ = {r, j} of Ư; r ∈ {r}, & j ∈ {r, j} the intersection from two ɱ.open sets Ʊ and ϑ be non.empty.

Example 3.3: Consider Ư = {r, j, k, w}, Ư/Ʀ = {{r}, {k}, {j, w}}, $\mathcal{H}$ = {j, w} ⊆ Ư. The $\mathcal{T}_Ʀ(\mathcal{H})$ = {Ư, {j, w}, ∅}, thereafter ɱ = {r} ∉ $\mathcal{T}_Ʀ(\mathcal{H})$. Then $ɱ_Ʀ(\mathcal{H})$ = {∅, {r}, {j, w}, {r, j, w}, Ư}. Let Ḃ = {q, s, t, p}, Ḃ/Ʀ = {{q}, {t}, {s, p}}, ϑ = {s, p} ⊆ Ḃ, then $\acute{\mathcal{T}}_Ʀ(\vartheta)$ = {Ḃ, {s, p}, ∅}, then ɱ́ = {q} ∉ $\acute{\mathcal{T}}_Ʀ(\vartheta)$. Then $ɱ́_Ʀ(\vartheta)$ = {Ḃ, {q}, {s, p}, {q, s, p}, ∅}. Define a projection ℘: Ư→ Ḃ; ℘(r) = q, ℘(j) = s, ℘(k) = t, ℘(w) = p. In contrast Ư be not Ƒ.ƜƆ.ɱ.Ҍ.₡, because the point q & s ∈ Ḃ; ∃two disjoint nonempty ɱ.open set Ʊ ={r}, & ϑ = {j, w} of Ư; r ∈ {r}, and j ∈ {j, w} the intersection from two ɱ.open sets Ʊ and ϑ; Ʊ ∩ ϑ = ∅.

Definition 3.4: Assum that Ɲ be a Ƒ.ƜƆ.ɱ.Ʈ.ς over Ḃ, be known as Ƒ.ƜƆ.ɱ extremally dis connected which be represented via the symbol (Ƒ.ƜƆ.ɱ.Æ.dis.₡), if a ɱ.closuer from each ɱ.open subset as yet to an ɱ.open subset.

Proposition 3.5: Suppose that Ɲ be a Ƒ.ƓƆ.ɱ.Ʈ.ς over Ḃ, if ɱ.Ʈ.ς $ɱ_{Ɽ}(W)$ = {Ɲ, ∅, $\mathcal{L}_{Ɽ}(W)$}, when W ⊆ Ɲ, thereafter Ɲ be Ƒ.ƓƆ.ɱ.Ƕ.Ȼ.

Proof: In ɱ.Ʈ.ς $ɱ_{Ɽ}(W)$ a ɱ.open sets non.empty are Ɲ and $\mathcal{L}_{Ɽ}(W)$, thereafter Ɲ ∩ $\mathcal{L}_{Ɽ}(W)$ = $\mathcal{L}_{Ɽ}(W)$ ≠ ∅. Hence Ɲ be a Ƒ.ƓƆ.ɱ.Ƕ.Ȼ.

Proposition 3.6: Suppose that Ɲ be a Ƒ.ƓƆ.ɱ.Ʈ.ς over Ḃ, if ɱ.Ʈ.ς $ɱ_{Ɽ}(W)$ = {Ɲ, ∅, $Ʋ_{Ɽ}(W)$}, when W ⊆ Ɲ, thereafter Ɲ be Ƒ.ƓƆ.ɱ.Ƕ.Ȼ.

Proof: In ɱ.Ʈ.ς $ɱ_{Ɽ}(W)$ a ɱ. open sets non. empty are Ɲ and $Ʋ_{Ɽ}(W)$, thereafter Ɲ ∩ $Ʋ_{Ɽ}(W)$ = $Ʋ_{Ɽ}(W)$ ≠ ∅. Hence Ɲ be a Ƒ.ƓƆ.ɱ.Ƕ.Ȼ.

Definition 3.7: Assum that Ɲ be a Ƒ.ƓƆ.ɱ.Ʈ.ς over Ḃ, be known as Ƒ.ƓƆ.ɱ. ultra connected which be represented via the symbol (Ƒ.ƓƆ.ɱ.Û.Ȼ), if for any two point u, v ∈ $Ɲ_b$, when b ∈ Ḃ will be the intersection of two disjoint non.empty ɱ.closed sets Ʊ, and ϑ from Ɲ when u ∈ Ʊ, and v ∈ ϑ be non.empty, otherwise it is not Ƒ.ƓƆ.ɱ.Û.Ȼ.

The example below be given to help understanding this term better.

Example 3.8: Consider Ư = {r, j, k}, Ư/Ɽ = {{j, k}, {r}}, $\mathcal{H}$ = {r} ⊆ Ư. The $\mathcal{T}_{Ɽ}(\mathcal{H})$ = {Ư, {r}, ∅}, thereafter ɱ = {r, j} ∉ $\mathcal{T}_{Ɽ}(\mathcal{H})$. Then $ɱ_{Ɽ}(\mathcal{H})$ = {∅, {r}, {r, j}, Ư}, a ɱ.closed sets are {∅, {j, k}, {k}, Ư}. Let Ḃ = {q, s, t}, Ḃ/Ɽ = {{q}, {s, t}}, ϑ = {q} ⊆ Ḃ, then $\acute{\mathcal{T}}_{Ɽ}(ϑ)$ = {Ḃ, ∅, {q}}, then ɱ́ = {q, s} ∉ $\acute{\mathcal{T}}_{Ɽ}(ϑ)$. Then $ɱ́_{Ɽ}(ϑ)$ = {Ḃ, {q, s}, {q}, ∅}, a ɱ.closed sets are {{t}, {s, t}, ∅, Ḃ}. Define a projection ℘: Ư→ Ḃ; ℘(r) = q, ℘(j) = s, ℘(k) = t. In contrast Ư be Ƒ.ƓƆ.ɱ.Û.Ȼ.Ʈ.ς, because, the point t and s ∈ Ḃ; k ∈{k} say Ʊ, j ∈ {j, k} say ϑ of Ư, and Ʊ ∩ ϑ ≠ ∅.

Example 3.9: Consider Ư = {x, y, z}, Ư/Ɽ = {{y, z}, {x}}, $\mathcal{H}$ = {x} ⊆ Ư. The $\mathcal{T}_{Ɽ}(\mathcal{H})$ = {Ư, ∅, {x}}, then ɱ = {x, z} ∉ $\mathcal{T}_{Ɽ}(\mathcal{H})$. Then $ɱ_{Ɽ}(\mathcal{H})$ = {∅, {x}, {x, y}, {x, z}, Ư}. a ɱ.closed sets are {∅, {y, z}, {z}, {y}, Ư}. Let Ḃ = {q, w, e}, Ḃ/Ɽ = {{w, e}, {q}}, ϑ = {q} ⊆ Ḃ, then $\acute{\mathcal{T}}_{Ɽ}(ϑ)$ = {Ḃ, ∅, {q}}, then ɱ́ = {q, e}∉ $\acute{\mathcal{T}}_{Ɽ}(ϑ)$. Then $ɱ́_{Ɽ}(ϑ)$ = {Ḃ, ∅, {q}, {q, w}, {q, e}} a ɱ.closed sets are {∅, {w, e}, {e}, {w}, Ư}. Define a projection ℘: Ư→ Ḃ; ℘(x) = q, ℘(y) = w, ℘(z) = e, thereafter Ư be not Ƒ.ƓƆ.ɱ.Û.Ȼ.Ʈ.ς, since, the point e and w ∈ Ḃ; z ∈{z} say Ʊ, y ∈ {y}say ϑ of Ư, and Ʊ ∩ ϑ = ∅.

Definition 3.10: Assum that Ɲ be a Ƒ.ƓƆ.ɱ.Ʈ.ς over Ḃ, be known as Ƒ.ƓƆ.ɱ jointly connected which be represented via the symbol (Ƒ.ƓƆ.ɱ.Ĵ.Ȼ), when it be both Ƒ.ƓƆ.ɱ.Ƕ.Ȼ, and Ƒ.ƓƆ.ɱ.Û.Ȼ.Ʈ.ς, otherwise it is not Ƒ.ƓƆ.ɱ.Ĵ.Ȼ.

Example 3.11: Similar to Example (4.14), Ư be a Ƒ.ƓƆ.ɱ.Ƕ.Ȼ, the point q and s ∈ Ḃ; r ∈{r} say Ʊ, j ∈ {j, r} say ϑ, and Ʊ ∩ ϑ ≠ ∅, and Ư also Ƒ.ƓƆ.ɱ.Û.Ȼ, since because, the point t and s ∈ Ḃ; k ∈{k} say Ʊ, j ∈ {j, k} say ϑ of Ư be ɱ.closed, and Ʊ ∩ ϑ ≠ ∅. Hence, Ư be Ƒ.ƓƆ.ɱ.Ĵ.₡.Ʈ.ϛ.

4. Discussion and Conclusion

In this study, we explored the connected fibrewise micro topology's significance in terms of theories, hypotheses, and observations, as well as the non. connected fibrewise micro topology's significance in terms from hypotheses, suggestions, and a declaration of scientific trend, We also defined fibrewise micro ultraconnected and fibrewise micro hyper connected environments and investigated their features. We also introduced certain micro functions and characterize the micro hyper connectedness features. The ability to stay connected at all times.

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