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27th October 2021

Jointly Organized by

Department of Biological Science, Physical Science and Computational Science

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ABOUT THE INSTITUTION

A nations's growth is in proportion to education and intelligence spread among the masses. Having this idealistic vision, two great philanthropists late. S.P. Nallamuthu Gounder and Late. Arutchelver Padmabhushan Dr.N.Mahalingam formed an organization called Pollachi Kalvi Kazhagam, which started NGM College in 1957, to impart holistic education with an objective to cater to the higher educational needs of those who wish to aspire for excellence in knowledge and values. The College has achieved greater academic distinctions with the introduction of autonomous system from the academic year 1987-88. The college has been Re-Accredited by NAAC and it is ISO 9001 : 2015 Certified Institution. The total student strength is around 6000. Having celebrated its Diamond Jubilee in 2017, the college has blossomed into a premier Post-Graduate and Research Institution, offering 26 UG, 12 PG, 13 M.Phil and 10 Ph.D Programmes, apart from Diploma and Certificate Courses. The college has been ranked within Top 100 (72nd Rank) in India by NIRF 2021.

ABOUT CONFERENCE

The International conference on “Emerging Trends in Science and Technology (ETIST-2021)” is being jointly organized by Departments of Biological Science, Physical Science and Computational Science - Nallamuthu Gounder Mahalingam College, Pollachi along with ISTE, CSI, IETE, IEE & RIYASA LABS on 27th OCT 2021. The Conference will provide common platform for faculties, research scholars, industrialists to exchange and discus the innovative ideas and will promote to work in interdisciplinary mode.

COMPLETELYπgγ* CONTINUOUS MAPPINGS IN INTUITIONISTIC FUZZY TOPOLOGICAL SPACES

K. Sakthivel[1], M. Manikandan[2],R. Santhi[3]

ABSTRACT: In this paper we have introduced a new class of mappings called as an Intuitionistic Fuzzy Completely πgγ* continuous mappings in intuitionistic fuzzy topological spaces. A mapping f: (X, τ)□(Y, □) is called an intuitionistic fuzzy completely πgγ* continuous mapping if $f^{-1}(B)$ is an intuitionistic fuzzy regular closed set in (X, τ) for every intuitionistic fuzzy πgγ* closed set B of (Y,□). Also we have investigated the relations between Intuitionistic Fuzzy Completely πgγ* continuous mappings and existing intuitionistic fuzzy continuous mappings with suitable examples.

Keywords: Intuitionistic fuzzy topology, Intuitionistic fuzzy closed set, Intuitionistic fuzzy continuous mappings, Intuitionistic fuzzy πgγ* closed set, Intuitionistic fuzzy πgγ* continuous mappings and Intuitionistic fuzzy completely πgγ* continuous mappings.

1. INTRODUCTION

The concept of intuitionistic fuzzy sets was introduced by Atanassov [1] using the notion of fuzzy sets. On the other hand Coker [2] introduced intuitionistic fuzzy topological spaces using the notion of intuitionistic fuzzy sets. In this paper, we introduce intuitionistic fuzzy completely πgγ*continuous mappings and studied some of their basic properties. We have analyzed the relations of intuitionistic fuzzy completely πgγ*continuous mappings with existing intuitionistic fuzzy continuous mappings and intuitionistic fuzzy irresolute mappings.

2. PRELIMINARIES

Definition 2.1: [1] An intuitionistic fuzzy set (IFS in short) A in X is an object having the form

K. Sakthivel*[1], Department of Mathematics,Government Arts College, Udumalpet, Tamilnadu, India.E-mail:sakthivelaugust15@gmail.com

M. Manikandan*[2], Research Scholar, Department of Mathematics, Government Arts College, Udumalpet, Tamilnadu, India. E-mail:manikandan4342@gmail.com

R. Santhi*[3], Department of Mathematics, Nallamuthu Gounder Mahalingam College, Pollachi-642 002, Tamil Nadu, India.E-mail:santhifuzzy@yahoo.co.in

$$A = \{\langle x, \mu_A(x), \nu_A(x) \rangle / x \in X\}$$

where the functions $\mu_A(x): X \to [0, 1]$ and $\nu_A(x): X \to [0,1]$ denote the degree of membership (namely $\mu_A(x)$) and the degree of non-membership (namely $\nu_A(x)$) of each element $x \in X$ to the set A, respectively, and $0 \leq \mu_A(x) + \nu_A(x) \leq 1$ for each $x \in X$. Denote by IFS(X), the set of all intuitionistic fuzzy sets in X.

Definition 2.2: [1] Let A and B be IFSs of the form

$A = \{\langle x, \mu_A(x), \nu_A(x) \rangle / x \in X\}$ and $B = \{\langle x, \mu_B(x), \nu_B(x) \rangle / x \in X\}$.

Then

(i) $A \subseteq B$ if and only if $\mu A(x) \leq \mu B(x)$ and $\nu A(x) \geq \nu B(x)$ for all $x \in X$

(ii) A = B if and only if $A \subseteq B$ and $B \subseteq A$

(iii) $Ac = \{\langle x, \nu A(x), \mu A(x) \rangle / x \in X\}$

(iv) $A \cap B = \{\langle x, \mu A(x) \wedge \mu B (x), \nu A(x) \vee \nu B(x) \rangle / x \in X\}$

(v) $A \cup B = \{\langle x, \mu A(x) \vee \mu B (x), \nu A(x) \wedge \nu B(x) \rangle / x \in X\}$

For the sake of simplicity, we shall use the notation $A = \langle x, \mu_A, \nu_A \rangle$ instead of $A = \{\langle x, \mu_A(x), \nu_A(x) \rangle / x \in X$. Also for the sake of simplicity, we shall use the notation $A = \{\langle x, (\mu_A, \mu_B), (\nu_A, \nu_B) \rangle\}$ instead of $A = \langle x, (A/\mu_A, B/\mu_B), (A/\nu_A, B/\nu_B) \rangle$.

The intuitionistic fuzzy sets $0_\sim = \{\langle x, 0, 1 \rangle / x \in X\}$ and $1_\sim = \{\langle x, 1, 0 \rangle / x \in X\}$ are respectively the empty set and the whole set of X.

Definition 2.3: [2] An intuitionistic fuzzy topology (IFT in short) on X is a family τ of IFSs in X satisfying the following axioms.

(i) $0_\sim, 1_\sim \in \tau$

(ii) $G_1 \cap G_2 \in \tau$ for any $G_1, G_2 \in \tau$

(iii) $\cup G_i \in \tau$ for any family $\{G_i / i \in J\} \subseteq \tau$.

In this case the pair (X, τ) is called an intuitionistic fuzzy topological space (IFTS in short) and any IFS in τ is known as an intuitionistic fuzzy open set (IFOS in short) in X. The complement A^c of an IFOS A in IFTS (X, τ) is called an intuitionistic fuzzy closed set (IFCS in short) in X.

Definition 2.4: [2] Let (X, τ) be an IFTS and $A = \langle x, \mu_A, \nu_A \rangle$ be an IFS in X. Then the intuitionistic fuzzy interior and intuitionistic fuzzy closure are defined by

(i) $int(A) = \cup \{ G / G$ is an IFOS in X and $G \subseteq A \}$,

(ii) $cl(A) = \cap \{K / K$ is an IFCS in X and $A \subseteq K \}$.

Note that for any IFS A in (X, τ), we have $cl(A^c) = [int(A)]^c$ and $int(A^c) = [cl(A)]^c$.

Definition 2.5: [6] An IFS $A = \{ \langle x, \mu_A, \nu_A \rangle \}$ in an IFTS (X, τ) is said to be an

(i) *intuitionistic fuzzy semi open set* (IFSOS in short) if $A \subseteq cl(int(A))$,

(ii) *intuitionistic fuzzy α-open set* (IFαOS in short) if $A \subseteq int(cl(int(A)))$,

(iii) intuitionistic fuzzy regular openset (IFROS in short) if $A = int(cl(A))$.

Definition 2.6: [6] The union of IFROSs is called intuitionistic fuzzy π-open set (IFπOS in short) of an IFTS (X, τ). The complement of IFπOS is called intuitionistic fuzzy π-closed set (IFπCS in short).

Definition 2.7: [6] An IFS A = $\langle x, \mu_A, \nu_A \rangle$ in an IFTS (X, τ) is said to be an

(i) *intuitionistic fuzzy semi closed set* (IFSCS in short) if int(cl(A)) ⊆ A,

(ii) *intuitionistic fuzzy α-closed set* (IFαCS in short) if cl(int(cl(A)) ⊆ A,

(iii) intuitionistic fuzzy regular closedset (IFRCS in short) if A = cl(int((A).

Definition 2.8: [5] An IFS A of an IFTS (X, τ) is an

(i) intuitionistic fuzzy γ-open set (IFγOS in short) if A ⊆int(cl(A)) ∪ cl(int(A)),

(ii) intuitionistic fuzzy γ-closed set (IFγCS in short) if cl(int(A)) ∩ int(cl(A)) ⊆ A.

Definition 2.9: [14] Let A be an IFS in an IFTS (X, τ). Then

(i) sint(A) = ∪ { G / G is an IFSOS in X and G ⊆ A },

(ii) scl(A) = ∩ { K / K is an IFSCS in X and A ⊆ K }.

Note that for any IFS A in (X, τ), we have $scl(A^c) = (sint(A))^c$ and $sint(A^c) = (scl(A))^c$.

Definition 2.10: [15] An IFS Ain an IFTS (X,τ) is an

(i)intuitionistic fuzzy generalized closed set (IFGCS in short) if cl(A) ⊆ U whenever A ⊆ U and U is an IFOS in X.

(ii) intuitionistic fuzzy regular generalized closed set (IFRGCS in short) if cl(A) ⊆ Uwhenever A ⊆ U and U is an IFROS in X.

Definition 2.11: [14] An IFS A in an IFTS (X,τ) is said to be an intuitionistic fuzzy generalized semi closed set (IFGSCS in short) if scl(A) ⊆ U whenever A ⊆ U and U is an IFOS in(X, τ).

Definition 2.12: [11] An IFS A in (X, τ) is said to be an intuitionistic fuzzy πgγ* closed set (IFπgγ*CS in short) if cl(int(A)) ∩ int(cl(A)) ⊆ U whenever A ⊆ U and U is an IFπOS in (X, τ). The family of all IFπgγ*CSs of an IFTS (X, τ) is denoted by IFπgγ*C(X).

Result 2.13: Every IFCS, IFGCS, IFRCS, IFαCS is an IFπgγ*CS but the converses may not be true in general.

Definition 2.14: [11] An IFS A is said to be an intuitionistic fuzzy πgγ* open set (IFπgγ*OS in short) in (X, τ) if the complement A^c is an IFπgγ*CS in X. The family of all IFπgγ*OSs of an IFTS (X, τ) is denoted by IFπgγ*O(X).

Definition 2.15: [4] Let f be a mapping from an IFTS (X, τ) into an IFTS (Y, σ). Then f is said to be intuitionistic fuzzy continuous (IF continuous in short) if $f^{-1}(B)$ ∈ IFO(X) for every B∈σ.

Definition 2.16: [14] Let f be a mapping from an IFTS (X, τ) into an IFTS (Y, σ). Then f is said to be

(i) intuitionistic fuzzy semi continuous (IFS continuous in short) if $f^{-1}(B)$ ∈ IFSO(X) for every B ∈Y.

(ii) intuitionistic fuzzy α-continuous (IFα continuous in short) if $f^{-1}(B)$ ∈ IFαO(X) for every B ∈Y.

(iii) intuitionistic fuzzy pre continuous (IFP continuous in short) if $f^{-1}(B)$ ∈ IFPO(X) for every B ∈Y.

(iv) intuitionistic fuzzy almost continuous (IFA continuous in short) if $f^{-1}(B)$ is an IFOS in X for each IFROS B ∈ Y.

(v) intuitionistic fuzzy almost α generalized continuous (IFAαG continuous in short) if $f^{-1}(B)$ is an IFαGOS in X for each IFROS B ∈ Y.

Definition 2.17: [5] A mapping f: (X, τ) → (Y,σ) is called an *intuitionistic fuzzy γ continuous* (IFγ continuous in short) if $f^{-1}(B)$ is an IFγOS in (X, τ) for every B∈σ.

Definition 2.18: [15] Let f be a mapping from an IFTS (X, τ) into an IFTS (Y, σ). Then f is said to be an intuitionistic fuzzy generalized continuous (IFG continuous in short) if $f^{-1}(B)$ ∈ IFGCS(X) for every IFCS B in Y.

Definition 2.19: [10] Let f be a mapping from an IFTS (X, τ) into an IFTS (Y, σ). Then f is said to be an intuitionistic fuzzy alpha generalized continuous (IFαG continuous in short) if $f^{-1}(B)$ is an IFαGCS for every IFCS B in Y.

Definition 2.20: [14] A mapping f: (X, τ) → (Y,σ) is called an *intuitionistic fuzzy generalized semi continuous* (IFGS continuous in short) if $f^{-1}(B)$ is an IFGSCS in (X, τ) for every IFCS B of (Y,σ).

Definition 2.21: [10] Let f be a mapping from an IFTS (X, τ) into an IFTS (Y, σ). Then f is said to be an intuitionistic fuzzy alpha irresolute (IFα irresolute in short) if $f^{-1}(B)$ ∈ IFαCS(X) for every IFαCS B in Y.

Definition 2.22: [12] Let f be a mapping from an IFTS (X, τ) into an IFTS (Y, σ). Then f is said to be an *intuitionistic fuzzy πgγ* irresolute* (IFπgγ* irresolute in short) if $f^{-1}(B)$ ∈ IFπgγ*CS(X) for every IFπgγ*CS B in Y.

Definition 2.23: [10] An IFTS (X, τ) is an *intuitionistic fuzzy*$_{\alpha d}T_{1/2}$(IF$_{\alpha d}T_{1/2}$) space if every IFPCS is an IFOS in X.

Definition 2.24: [10] An IFTS (X, τ) is said to be an *intuitionistic fuzzy πgγ*c*$T_{1/2}$ (in short IFπgγ*c$T_{1/2}$) space if every IFπgγ*CS in X is an IFCS in X.

3. INTUITIONISTIC FUZZY COMPLETELY πgγ* CONTINUOUS MAPPINGS

In this section we have introduced intuitionistic fuzzy completely πgγ* continuous mapping and studied some of its properties.

Definition 3.1: A mapping f: (X, τ) → (Y,σ) is called an intuitionistic fuzzy completely πgγ* continuous (IFcπgγ* continuous in short) mapping if $f^{-1}(B)$ is an IFRCS in (X, τ) for every IFπgγ*CS B of (Y,σ).

Theorem 3.2: Every IFcπgγ* continuous mapping is an IF continuous mapping but converse is not true.

Proof: Let us consider a mapping f: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFCS in Y. Then B is an IFπgγ*CS in Y. Since f is an IFcπgγ*continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFCS in X. Hence the mapping f is an IF continuous mapping.

Example 3.3: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.2, 0.2), (0.5 0.7)⟩, G_2 = ⟨ x, (0.1, 0.3), (0.8, 0.6) ⟩ and G_3 = ⟨ y, (0.1, 0.3), (0.8, 0.6)⟩. Then τ = {$0_\sim$, G_1, G_2, $1_\sim$} and σ = {$0_\sim$, G_3, $1_\sim$} are IFT on X and Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u and f (b) = v. Then f is an IF continuous mapping. But f is not an IFcπgγ* continuous mapping, since B = ⟨ y, (0.7, 0.8), (0.1, 0.2) ⟩ is an IFπgγ*CS in Y but $f^{-1}(B)$ = ⟨ x, (0.7, 0.8), (0.1, 0.2) ⟩ is not an IFRCS in X.

Theorem 3.4: Every IFcπgγ* continuous mapping is an IFS continuous mapping but not conversely.

Proof: Assume that f: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFCS in Y. Then B is an IFπgγ*CS in Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFSCS in X. Hence f is an IFS continuous mapping.

Example 3.5: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.4, 0.2), (0.6, 0.6)⟩, G_2 = ⟨ x, (0.3, 0.2), (0.6, 0.7) ⟩ and G_3 = ⟨ y, (0.3, 0.2), (0.6, 0.7)⟩. Then τ = {$0_\sim$, G_1, G_2, $1_\sim$} and σ = {$0_\sim$, G_3, $1_\sim$} are IFT on X and Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u and f (b) = v. Then f is an IFS continuous mapping. But f is not an IFcπgγ* continuous mapping since B = ⟨ y, (0.4, 0.7), (0.4, 0.2) ⟩ is an IFπgγ*CS in Y but $f^{-1}(B)$ =⟨ x, (0.4, 0.7), (0.4, 0.2) ⟩ is not an IFRCS in X.

Theorem 3.6: Every IFcπgγ* continuous mapping is an IFG continuous mapping but converse does not exist.

Proof: Let us assume that f: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFCS in Y. This implies B is an IFπgγ*CS in Y. Since f is an IFcπgγ*continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFGCS in X. Hence f is an IFG continuous mapping.

Example 3.7: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.4, 0.2), (0.6, 0.6)⟩, G_2 = ⟨ x, (0.3, 0.2), (0.6, 0.8) ⟩ and G_3 = ⟨ y, (0.3, 0.2), (0.6, 0.8)⟩. Then τ = {$0_\sim$, G_1, G_2, $1_\sim$} and σ = {$0_\sim$, G_3, $1_\sim$} are IFT on X and Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u and f (b) = v. Then f is an IFG continuous mapping. But f is not an IFcπgγ* continuous mapping since B = ⟨ y, (0.5, 0.5), (0.4, 0.2) ⟩ is an IFπgγ*CS in Y but $f^{-1}(B)$ =⟨ x, (0.5, 0.5), (0.4, 0.2) ⟩ is not an IFRCS in X.

Theorem 3.8: Every IFcπgγ* continuous mapping is an IFα continuous mapping but not conversely.

Proof: Assume that f: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFCS in Y. This implies B is an IFπgγ*CS in Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFαCS in X. Hence f is an IFα continuous mapping.

Example 3.9: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.4, 0.2), (05, 0.6)⟩, G_2 = ⟨ x, (0.3, 0.1), (0.6, 0.2) ⟩ and G_3 = ⟨ y, (0.3, 0.1), (0.6, 0.2)⟩. Then we define τ = {$0_\sim$, G_1,G_2, $1_\sim$} and σ = {$0_\sim$, G_3, $1_\sim$} are IFT on Xand Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u and f (b) = v. Then f is an IFα continuous mapping. But f is not an IFcπgγ* continuous mapping since B = ⟨ y, (0.5, 0.7), (0.2, 0.1) ⟩ is an IFπgγ*CS in Y butf $^{-1}$(B) =⟨ x, (0.5, 0.7), (0.2, 0.1) ⟩ is not an IFRCS in X.

Theorem 3.10: Every IFcπgγ* continuous mapping is an IFGS continuous mapping but converse is not true.

Proof: Assume that f: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFCS in Y. This implies B is an IFπgγ*in Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFGSCS in X. Hence f is an IFGS continuous mapping.

Example 3.11: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.4, 0.2), (0.6, 0.6)⟩, G2 = ⟨ x, (0.1, 0.2), (0.6, 0.8) ⟩ and G_3 = ⟨ y, (0.1, 0.2), (0.6, 0.8)⟩. Then we define τ = {$0_\sim$, G_1,G_2, $1_\sim$} and σ = {$0_\sim$, G_3, $1_\sim$} are IFT on Xand Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u andf (b) = v. Then f is an IFGS continuous mapping. But f is not an IFcπgγ* continuous mapping since B = ⟨ y, (0.6, 0.8), (0.1, 0.1) ⟩ is an IFπgγ*CS in Y butf $^{-1}$(B) =⟨ x, (0.6, 0.8), (0.1, 0.1) ⟩ is not an IFRCS in X.

Theorem 3.12: Every IFcπgγ* continuous mapping is an IFαG continuous mapping but not conversely.

Proof: Assume thatf: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFCS in Y. Then B is an IFπgγ*CS in Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFαGCS in X. Hence f is an IFαG continuous mapping.

Example 3.13: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.4, 0.2), (0.4, 0.6)⟩, G2 = ⟨ x, (0.3, 0.1), (0.6, 0.7) ⟩ and G_3 = ⟨ y, (0.3, 0.1), (0.6, 0.7)⟩. Then we define τ = {$0_\sim$, G_1,G_2, $1_\sim$} and σ = {$0_\sim$, G_3, $1_\sim$} are IFT on Xand Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u and f (b) = v. Then f is an IFαG continuous mapping. But f is not an IFcπgγ* continuous mapping since B = ⟨ y, (0.7, 0.7), (0.2, 0.2) ⟩ is an IFπgγ*CS in Y but $f^{-1}(B)$ =⟨ x, (0.7, 0.7), (0.2, 0.2) ⟩ is not an IFRCS in X.

Theorem 3.14: Every IFcπgγ*continuous mapping is an IFγ continuous mapping but converse is not true.

Proof: Assume that f: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFCS in Y. This implies B is an IFπgγ*CS in Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFγCS in X. Hence f is an IFγ continuous mapping.

Example 3.15: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.4, 0.2), (0.6, 0.6)⟩, G_2 = ⟨ x, (0.2, 0.1), (0.6, 0.4) ⟩ and G_3 = ⟨ y, (0.2, 0.1), (0.6, 0.4)⟩. Then we define τ = {$0_\sim$, G_1,G_2, $1_\sim$} and σ = {$0_\sim$, G_3, $1_\sim$} are IFT on X and Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u and f (b) = v. Then f is an IFγ continuous mapping. But f is not an IFcπgγ* continuous mapping since B = ⟨ y, (0.5, 0.8), (0.2, 0.1) ⟩ is an IFπgγ*CS in Y but$f^{-1}(B)$ =⟨ x, (0.5, 0.8), (0.2, 0.1) ⟩ is not an IFRCS in X.

Theorem 3.16: Amapping f: X → Y is an IFcπgγ* continuous mapping if and only if the inverse image of each IFπgγ*OS in Y is anIFROS in X.

Proof: Necessity: Let A be an IFπgγ*OS in Y. This implies A^c is an IFπgγ*CS in Y. Since f is an IFcπgγ* continuous, $f^{-1}(A^c)$ is IFRCS in X. Since $f^{-1}(A^c) = (f^{-1}(A))^c$, $f^{-1}(A)$ is an IFROS in X.

Sufficiency: Let A be an IFπgγ*CS in Y. This implies A^c is an IFπgγ*OS in Y. By hypothesis $f^{-1}(A^c)$ is an IFROS in X. Since $f^{-1}(A^c) = (f^{-1}(A))^c$, $f^{-1}(A)$ is an IFRCS in X. Hence f is an IFcπgγ*continuous mapping.

Remark3.17: Every IFcπgγ* continuous mapping is an IFA continuous mapping but not conversely.

Proof: Assume that f: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFRCS in Y. Then B is an IFπgγ*CS in Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFCS in X. Hence f is an IFA continuous mapping.

Example 3.18: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.2, 0.2), (0.6, 0.7)⟩, G_2 = ⟨ x, (0.1, 0.2), (0.8, 0.8) ⟩ and G_3 = ⟨ y, (0.1, 0.2), (0.8, 0.8)⟩. Then τ = {$0_\sim$, G_1, G_2, $1_\sim$} and σ = {$0_\sim$, G_3, $1_\sim$} are IFT on Xand Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u and f (b) = v. Then f is an IFA continuous mapping. But f is not an IFcπgγ*continuous mapping since B = ⟨ y, (0.7, 0.8), (0.1, 0.2) ⟩ is an IFπgγ*CS in Y but $f^{-1}(B)$ =⟨ x, (0.7, 0.8), (0.1, 0.2) ⟩ is not an IFRCS in X.

Theorem 3.19: Every IFcπgγ* continuous mapping is an IFπgγ* continuous mapping but not conversely.

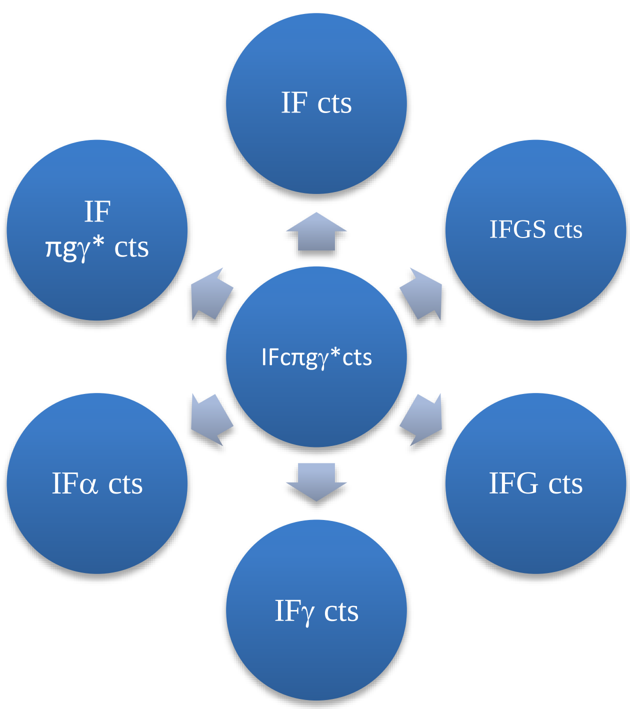
Proof: Assume that f: (X, τ) → (Y,σ) is an IFcπgγ* continuous mapping. Let B be an IFCS in Y. This implies B is an IFπgγ*CS in Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFπgγ*CS in X. Hence f is an IFπgγ*continuous mapping.

Example 3.20: Let X = {a, b}, Y = {u, v} and G_1 = ⟨ x, (0.4, 0.2), (0.6, 0.6)⟩, G_2 = ⟨ x, (0.2, 0.1), (0.6, 0.4) ⟩ and G_3 = ⟨ y, (0.2, 0.1), (0.6, 0.4)⟩. Then we define τ = {$0_{\sim}$, G_1,G_2, $1_{\sim}$} and σ = {$0_{\sim}$, G_3, $1_{\sim}$} are IFT on Xand Y respectively. Define a mapping f: (X, τ) → (Y,σ) by f (a) = u and f (b) = v. Then f is an IFπgγ* continuous mapping. But f is not an IFcπgγ* continuous mapping since B = ⟨ y, (0.6, 0.8), (0.2, 0.1) ⟩ is an IFπgγ*CS in Y but $f^{-1}(B)$ = ⟨ x, (0.6, 0.8), (0.2, 0.1) ⟩ is not an IFRCS in X.

Theorem 3.21: If f : (X, τ) → (Y, σ) is an IFAαG continuous mapping and g : (Y, σ) → (Z, η) is an IFcπgγ* continuous mapping, then g o f :(X, τ) → (Z, η) is an IFAαG continuous mapping.

Proof: Let A be an IFRCS in Z. Then A is an IFπgγ*CS in Z. Since g is an IFcπgγ* continuous mapping, $g^{-1}(A)$ is an IFRCS in Y. Since f is an IFAαG continuous mapping, $f^{-1}(g^{-1}(A))$ is an IFαGCS in X. Hence g o f is an IFAαG continuous mapping.

The relations between various types of intuitionistic fuzzy continuity are given in the following diagram. In this diagram 'cts' means continuous mapping.



The reverse implications are not true in general.

Theorem 3.22: If f : (X, τ) → (Y, σ) is an IFA continuous mapping and g : (Y, σ) → (Z, η) is an IFcπgγ*continuous mapping, then g o f:(X, τ) → (Z, η) is an IF continuous mapping.

Proof: Let A be an IFCS in Z. Then A is an IFπgγ*CS in Z. Since g is an IFcπgγ* continuous mapping, $g^{-1}(A)$ is an IFRCS in Y. As f is an IFA continuous mapping, $f^{-1}(g^{-1}(A))$ is an IFCS in X. Hence g o f is an IF continuous mapping.

Theorem 3.23: Let f: (X, τ) → (Y,σ) be a mapping from an IFTS X into an IFTS Y. Then the following conditions are equivalent if X is an $IF_{\alpha d}T_{1/2}$ space.

(i) f is an IFcπgγ* continuous mapping

(ii) If B is an IFπgγ*CS in Y then $f^{-1}(B)$ is an IFRCS in X

(iii) $cl(int(f^{-1}(B)))\subseteq f^{-1}(B)$ for every IFπgγ*CS B in Y.

Proof: (i) ⇒ (ii):is obviously true.

(ii) ⇒ (iii): Let B be any IFπgγ*CS in Y. Then by hypothesis $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFαCS in X. Hence $cl(int(cl(f^{-1}(B))))\subseteq f^{-1}(B)$.This implies $cl(int(f^{-1}(B)))\subseteq f^{-1}(B)$.

(iii) ⇒ (i): Let B be an IFπgγ*OS in Y. Then its complement B^c is an IFπgγ*CS in Y. By hypothesis $cl(int(f^{-1}(B^c)))\subseteq f^{-1}(B^c)$. Then $f^{-1}(B^c)$ is an IFPCS in X. Since X is an $IF_{\alpha d}T_{1/2}$ space, $f^{-1}(B^c)$ is IFOS in X. That is $f^{-1}(B^c) = int(f^{-1}(B^c))$. Therefore $cl(int(f^{-1}(B^c)))\subseteq f^{-1}(B^c) = int(f^{-1}(B^c))\subseteq cl(int(f^{-1}(B^c)))$. Hence $f^{-1}(B^c) = cl(int(f^{-1}(B^c)))$. Therefore $f^{-1}(B^c)$ is an IFRCS in X. Therefore $f^{-1}(B)$ is an IFROS in X. Hence f is an IFcπgγ* continuous mapping.

Theorem 3.24: Every IFcπgγ*continuous mapping is an IFα irresolute mapping but not conversely.

Proof: Assume that f: (X, τ) → (Y, σ) is an IFcπgγ* continuous mapping. Let B be an IFαCS in Y. Then B is an IFπgγ*CSin Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFαCS in X. Hence f is an IFα irresolute mapping.

Example 3.25: Let X = {a, b}, Y = {u, v} and $G_1 = \langle x, (0.4, 0.2), (0.6, 0.7) \rangle$, $G_2 = \langle x, (0.1, 0.2), (0.8, 0.8) \rangle$ and $G_3 = \langle y, (0.1, 0.2), (0.8, 0.8) \rangle$. Then $\tau = \{0_\sim, G_1, G_2, 1_\sim\}$ and $\sigma = \{0_\sim, G_3, 1_\sim\}$ are IFT on Xand Y respectively. Define a mapping f: (X, τ) → (Y, σ) by f(a) = u and f(b) = v. Then f is an IFα irresolute mapping. But f is not an IFcαG continuous mapping, since $B = \langle y, (0.7, 0.8), (0.1, 0.2) \rangle$ is an IFπgγ*CS in Y but $f^{-1}(B) = \langle x, (0.7, 0.8), (0.1, 0.2) \rangle$ is not an IFRCS in X.

Theorem 3.26: Every IFcπgγ* continuous mapping is an IFπgγ* irresolute mapping.

Proof: Assume that f: (X, τ) → (Y, σ) is an IFcπgγ*continuous mapping. Let B be an IFπgγ*CS in Y. Since f is an IFcπgγ* continuous mapping, $f^{-1}(B)$ is an IFRCS in X. This implies $f^{-1}(B)$ is an IFπgγ*CS in X. Hence f is an IFπgγ* irresolute mapping.

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BIOGRAPHY

Dr. K. Sakthivel is presently working as Assistant Professor in Government Arts College, Udumalplet, Tamil Nadu. He has published 15 papers in national and international journals. His area of research is Topology, fuzzy Topology and Intuitionistic fuzzy Topology. He has 18 years of teaching experience and 6years of research experience.

M. Manikandan M.Sc., M.Phil.,M.C.A. is a research scholar in the department of Mathematic, Government Arts College, Udumalplet, Tamil Nadu.He has published 5 papers in national and international journals. His area of research is Topology, fuzzy Topology and Intuitionistic fuzzy Topology. He has 8 years of teaching experience and 3 years of research experience.

Dr. R. Santhi M.Sc., M.Phil., Ph.D., P.G.D.C.A is presently working as an Assistant Professor of Mathematics, Nallamuthu Gounder Mahalingam College, Pollachi, Coimbatore, Tamil Nadu. She has published 56 papers in national and international journals. Her area of research is Topology, fuzzy Topology and Intuitionistic fuzzy Topology. She has 23 years of teaching experience and 19 years of research experience. She is a Life member of Indian Science Congress Association, Kerala Mathematical Association and Ramanujan Mathematical Society.