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Almost Slightly $\nu g-$Continuous Functions

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Abstract

In this paper we discuss a new type of continuous functions called almost slightly $\nu g-$continuous functions; its properties and interrelation with other continuous functions are studied.

Keywords: *slightly continuous functions; slightly semi-continuous functions; slightly $\beta-$continuous functions; slightly $\gamma-$continuous functions and slightly $\nu-$continuous functions.*

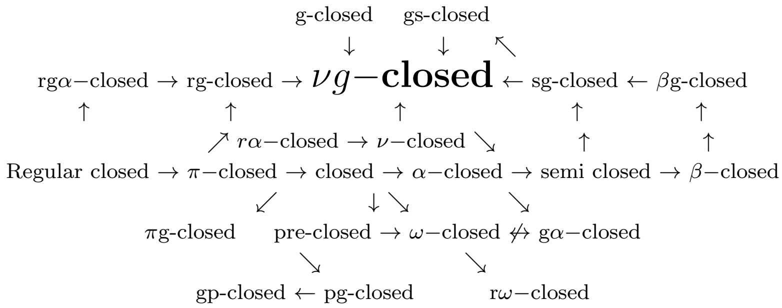
1. Introduction

T.M.Nour introduced slightly semi-continuous functions during the year 1995. After him T.Noiri and G.I.Ghae further studied slightly semi-continuous functions on 2000. During 2001 T.Noiri individually studied slightly $\beta-$ continuous functions. C.W.Baker introduced slightly precontinuous functions. Erdal Ekici and M. Caldas studied slightly $\gamma-$continuous functions. Arse Nagli Uresin and others studied slightly $\delta-$continuous functions. Recently the Author of the present paper studied slightly $\nu g-$continuous functions. Inspired with these developements the author introduce in this paper a new variety of slightly continuous functions called almost slightly $\nu g-$continuous function and study its basic properties; interrelation with other type of such functions available in the literature. Throughout the paper a space X means a topological space (X,τ).

2. Preliminaries

Definition 2.1: $A \subset X$ is called
(i) closed[resp: Semi-closed; ν-closed] if its complement is open[resp:semi-open; $\nu-$open].
(ii) $r\alpha-$closed if $\exists U \in \alpha O(X)] \ni U \subset A \subset \alpha\overline{(U)}]$.
(iii)semi-$\theta-$open if it is the union of semi-regular sets and its complement is semi-$\theta-$closed.
(iv) Regular closed[resp: $\alpha-$closed; pre-closed; $\beta-$closed] if $A = \overline{A^o}$[resp: $\overline{((\overline{A^o}))^o} \subseteq A$; $\overline{(A^o)} \subseteq A$; $\overline{(\overline{A})^o} \subseteq A$].
(v) g-closed[resp: rg-closed] if $\overline{A} \subseteq U$ whenever $A \subseteq U$ and U is open in X.
(vi)sg-closed[resp: gs-closed] if $s(\overline{A}) \subseteq U$ whenever $A \subseteq U$ and U is semi-open{open} in X.
(vii)pg-closed[resp: gp-closed; gpr-closed] if $p(\overline{A}) \subseteq U$ whenever $A \subseteq U$ and U is pre-open{open; regular-open} in X.
(viii) αg-closed[resp: g$\alpha-$closed; rgα-closed] if $\alpha(\overline{A}) \subseteq U$ whenever $A \subseteq U$ and U is{$\alpha-$open; r$\alpha-$open}open in X.
(ix) νg-closed if $\nu(\overline{A}) \subseteq U$ whenever $A \subseteq U$ and U is $\nu-$open in X.
(x) clopen[resp: r-clopen] if it is both open and closed[resp: regular-open and regular-closed]

Note 1: From the above definitions we have the following interrelations among the closed sets.



Definition 2.2: A function f:X→ Y is said to be
(i) continuous[resp: nearly-continuous; r$\alpha-$ continuous; $\nu-$ continuous; $\alpha-$ continuous; semi-continuous; $\beta-$ continuous; pre-continuous] if inverse image of each open set is open[resp: regular-open; rα -open; ν -open; α -open; semi-open; β -open; preopen].
(ii) nearly-irresolute[resp: r$\alpha-$ irresolute; $\nu-$ irresolute; $\alpha-$ irresolute; irresolute; $\beta-$irresolute; pre-irresolute] if inverse image of each regular-open[resp: rα-open; ν -open; α -open; semi-open; β-open; preopen] set is regular-open[resp: rα-open; ν -open; α -open; semi-open; β -open; preopen].
(iii) almost continuous[resp: almost r$\alpha-$continuous; almost $\nu-$continuous; almost $\alpha-$continuous; almost semi-continuous; almost $\beta-$continuous; almost

pre-continuous] if for each $x \in X$ and each open set (V, f(x)), there exists an open[resp: rα-open; ν-open; α-open; semi-open; β-open; preopen] set $(U, x) \ni f(U) \subset (\overline{V})^o$.
(iv) weakly continuous[resp: weakly nearly-continuous; weakly r$\alpha-$continuous; weakly $\nu-$continuous; weakly $\alpha-$continuous; weakly semi-continuous; weakly $\beta-$continuous; weakly pre-continuous] if for each $x \in X$ and each open set (V, f(x)), there exists an open[resp: regular-open; rα-open; ν-open; α-open; semi-open; β-open; preopen] set $(U, x) \ni f(U) \subset \overline{V}$.
(v) slightly continuous[resp: slightly semi-continuous; slightly pre-continuous; slightly $\beta-$continuous; slightly $\gamma-$continuous; slightly $\alpha-$continuous; slightly r-continuous; slightly $\nu-$continuous] at $x \in X$ if for each clopen subset V in Y containing $f(x), \exists U \in \tau(X)[\exists U \in SO(X); \exists U \in PO(X); \exists U \in \beta O(X); \exists U \in \gamma O(X); \exists U \in \alpha O(X); \exists U \in RO(X); \exists U \in \nu O(X)]$ containing x such that $f(U) \subseteq V$.
(vi) slightly continuous[resp: slightly semi-continuous; slightly pre-continuous; slightly $\beta-$ continuous; slightly $\gamma-$ continuous; slightly $\alpha-$ continuous; slightly r-continuous; slightly $\nu-$ continuous] if it is slightly-continuous[resp:slightly semi-continuous; slightly pre-continuous; slightly $\beta-$ continuous; slightly $\gamma-$ continuous; slightly $\alpha-$continuous; slightly r-continuous; slightly $\nu-$continuous] at each $x \in X$.
(vii) almost strongly $\theta-$semi-continuous[resp: strongly $\theta-$semi-continuous] if for each $x \in X$ and for each $V \in \sigma(Y, f(x)), \exists U \in SO(X, x) \ni f(s\overline{(U)}) \subset s\overline{(V)}$[resp: $f(s\overline{(U)}) \subset V$].

Definition 2.3: A function f:X$\rightarrow$ Y is said to be [almost-] slightly g - continuous [resp: [almost-] slightly sg - continuous; [almost-] slightly pg-continuous; [almost-] slightly $\beta g-$ continuous; [almost-] slightly $\gamma g-$ continuous; [almost-] slightly $\alpha g-$ continuous; [almost-] slightly rg-continuous] at $x \in X$ if for each $V \in CO(Vf(x))$, [resp: $V \in RCO(Vf(x))$], $\exists U \in GO(X, x)[\exists U \in SGO(X, x); \exists U \in PGO(X, x); \exists U \in \beta GO(X, x); \exists U \in \gamma GO(X, x); \exists U \in \alpha GO(X, x); \exists U \in RGO(X, x)] \ni f(U) \subseteq V$, and [almost-] slightly g-continuous [resp: [almost-] slightly sg-continuous; [almost-] slightly pg-continuous; [almost-] slightly $\beta g-$ continuous; [almost-] slightly $\gamma g-$ continuous; [almost-] slightly $\alpha g-$ continuous; [almost-]slightly rg-continuous] if it is [almost-]slightly g-continuous [resp:[almost-]slightly sg-continuous; [almost-] slightly pg-continuous; [almost-]slightly $\beta g-$ continuous; [almost-] slightly $\gamma g-$ continuous; [almost-] slightly $\alpha g-$ continuous; [almost-] slightly rg-continuous] at each $x \in X$.

Definition 2.4: X is said to be a
(i) compact[resp: nearly-compact; r$\alpha-$ compact; $\nu-$ compact; $\alpha-$ compact; semi-compact; $\beta-$ compact; pre-compact; mildly-compact] space if every open [resp: regular-open; rα -open; ν-open; α -open; semi-open; β -open; preopen;

clopen] cover has a finite subcover.
(ii) countably-compact[resp: countably-nearly-compact; countably - r$\alpha-$ compact; countably - $\nu-$ compact; countably- $\alpha-$ compact; countably - semi - compact; countably - $\beta-$ compact; countably-pre-compact; mildly-countably compact] space if every countable open[resp: regular-open; rα - oover.
(iii) closed-compact[resp: closed-nearly-compact; closed-r $\alpha-$ compact; closed-$\nu-$ compact; closed-$\alpha-$ compact; closed-semi-compact; closed-$\beta-$compact; closed-pre-compact] space if every closed[resp: regular-closed; rα-closed; ν - closed; α -closed; semi-closed; β-closed; preclosed] cover has a finite subcover.
(iv) Lindeloff [resp: nearly-Lindeloff; r$\alpha-$ Lindeloff; $\nu-$ Lindeloff; $\alpha-$Lindeloff; semi-Lindeloff; $\beta-$ Lindeloff; pre-Lindeloff; mildly-Lindeloff] space if every open[resp: regular-open; rα -open; ν-open; α -open; semi-open; β -open; pre-open; clopen] cover has a countable subcover.
(v) Extremally disconnected[briefly e.d] if the closure of each open set is open.

Definition 2.5: X is said to be a
(i) T_0[resp: r-T_0; r$\alpha - T_0$; $\nu - T_0$; $\alpha - T_0$; semi-T_0; $\beta - T_0$; pre-T_0; Ultra T_0] space if for each $x \neq y \in X \exists U \in \tau(X)$[resp: rO(X); r$\alpha$O(X); νO(X); αO(X); SO(X); βO(X); PO(X); CO(X)] containing either x or y.
(ii) T_1[resp: r-T_1; r$\alpha - T_1$; $\nu - T_1$; $\alpha - T_1$; semi-T_1; $\beta - T_1$; pre-T_1; Ultra T_1] space if for each $x \neq y \in X \exists U, V \in \tau(X)$[resp: rO(X); r$\alpha$O(X); νO(X); αO(X); SO(X); βO(X); PO(X): CO(X)] such that $x \in U - V$ and $y \in V - U$.
(iii)T_2[resp: r-T_2; r$\alpha - T_2$; $\nu - T_2$; $\alpha - T_2$; semi-T_2; $\beta - T_2$; pre-T_2; Ultra T_2] space if for each $x \neq y \in X \exists U, V \in \tau(X)$[resp: rO(X); r$\alpha$O(X); νO(X); αO(X); SO(X); βO(X); PO(X); CO(X)] such that $x \in U$; $y \in V$ and $U \cap V = \phi$.
(iv) C_0[resp: r-C_0; r$\alpha - C_0$; $\nu - C_0$; $\alpha - C_0$; semi-C_0; $\beta - C_0$; pre-C_0; Ultra C_0] space if for each $x \neq y \in X \exists U \in \tau(X)$[resp: rO(X); r$\alpha$O(X); νO(X); αO(X); SO(X); βO(X); PO(X); CO(X)]whose closure contains either x or y
(v) C_1[resp: r-C_1; r$\alpha - C_1$; $\nu - C_1$; $\alpha - C_1$; semi-C_1; $\beta - C_1$; pre-C_1; Ultra C_1] space if for each $x \neq y \in X \exists U, V \in \tau(X)$[resp: rO(X); r$\alpha$O(X); νO(X); αO(X); SO(X); βO(X); PO(X); CO(X)]whose closure contains x and y.
(vi)C_2[resp: r-C_2; r$\alpha - C_2$; $\nu - C_2$; $\alpha - C_2$; semi-C_2; $\beta - C_2$; pre-C_2; Ultra C_2] space if for each $x \neq y \in X \exists U, V \in \tau(X)$[resp: rO(X); r$\alpha$O(X); νO(X); αO(X); SO(X); βO(X); PO(X); CO(X)]whose closure contains x and y and $U \cap V = \phi$.
(vii) D_0[resp: r-D_0; r$\alpha - D_0$; $\nu - D_0$; $\alpha - D_0$; semi-D_0; $\beta - D_0$; pre-D_0; Ultra D_0] space if for each $x \neq y \in X \exists U \in D(X)$[resp: rD(X); r$\alpha$D(X); νD(X); αD(X); SD(X); βD(X); PD(X); COD(X)] containing either x or y.
(viii) D_1[resp: r-D_1; r$\alpha - D_1$; $\nu - D_1$; $\alpha - D_1$; semi-D_1; $\beta - D_1$; pre-D_1; Ultra D_1] space if for each $x \neq y \in X \exists U, V \in D(X)$[resp: rD(X); r$\alpha$D(X); νD(X); αD(X); SD(X); βD(X); PD(X); COD(X)]$\ni x \in U - V$ and $y \in V - U$.
(ix)D_2[resp: r-D_2; r$\alpha - D_2$; $\nu - D_2$; $\alpha - D_2$; semi-D_2; $\beta - D_2$; pre-D_2; Ultra

D_2] space if for each $x \neq y \in X \exists U, V \in D(X)$[resp: rD(X); r$\alpha$D(X); νD(X); αD(X); SD(X); βD(X); PD(X); CD(X)] such that $x \in U$; $y \in V$ and $U \cap V = \phi$.
(x) R_0[resp: r-R_0; r$\alpha - R_0$; $\nu - R_0$; $\alpha - R_0$; semi-R_0; $\beta - R_0$; pre-R_0; Ultra R_0] space if for each $x \in X \exists U \in \tau(X)$[resp: RO(X); r$\alpha$O(X); νO(X); αO(X); SO(X); βO(X); PO(X); CO(X)]$\overline{\{x\}} \subseteq U$[resp: $r\overline{\{x\}} \subseteq U; \nu\overline{\{x\}} \subseteq U; \alpha\overline{\{x\}} \subseteq U; s\overline{\{x\}} \subseteq U$] whenever $x \in U \in \tau(X)$[resp: $x \in U \in RO(X); x \in U \in \nu O(X); x \in U \in \alpha O(X); x \in U \in SO(X)$]
(xi) R_1[resp: r-R_1; r$\alpha - R_1$; $\nu - R_1$; $\alpha - R_1$; semi-R_1; $\beta - R_1$; pre-R_1; Ultra R_1] space if for $x, y \in X \ni \overline{\{x\}} \neq \overline{\{y\}}$[resp:$\ni r\overline{\{x\}} \neq r\overline{\{y\}}; \ni r\alpha\overline{\{x\}} \neq r\alpha\overline{\{y\}}; \ni \nu\overline{\{x\}} \neq \nu\overline{\{y\}}; \ni \alpha\overline{\{x\}} \neq \alpha\overline{\{y\}}; \ni \nu\overline{\{x\}} \neq \nu\overline{\{y\}}; \ni \alpha\overline{\{x\}} \neq \alpha\overline{\{y\}}; \ni s\overline{\{x\}} \neq s\overline{\{y\}}; \ni \beta\overline{\{x\}} \neq \beta\overline{\{y\}}; \ni p\overline{\{x\}} \neq p\overline{\{y\}}; \ni CO\overline{\{x\}} \neq CO\overline{\{y\}};$]$V \in \tau(X)$ $\exists$ disjoint $U; V \in \tau(X) \ni \overline{\{x\}} \subseteq U$[resp: $RO(X) \ni r\overline{\{x\}} \subseteq U; R\alpha O(X) \ni r\alpha\overline{\{x\}} \subseteq U; \nu O(X) \ni \nu\overline{\{x\}} \subseteq U; RO(X) \ni \alpha\overline{\{x\}} \subseteq U; SO(X) \ni s\overline{\{x\}} \subseteq U; \beta O(X) \ni \beta\overline{\{x\}} \subseteq U; PO(X) \ni p\overline{\{x\}} \subseteq U; CO(X) \ni co\overline{\{x\}} \subseteq U$] and $\overline{\{y\}} \subseteq V$ [resp: $RO(X) \ni r\overline{\{y\}} \subseteq V; R\alpha O(X) \ni r\alpha\overline{\{y\}} \subseteq V; \nu O(X) \ni \nu\overline{\{y\}} \subseteq V; RO(X) \ni \alpha\overline{\{y\}} \subseteq V; SO(X) \ni s\overline{\{y\}} \subseteq V; \beta O(X) \ni \beta\overline{\{y\}} \subseteq V; PO(X) \ni p\overline{\{y\}} \subseteq V; CO(X) \ni co\overline{\{y\}} \subseteq V$].

Lemma 2.1:
(i) Let A and B be subsets of a space X, if $A \in \nu O(X)$ and $B \in RO(X)$, then $A \cap B \in \nu O(B)$.
(ii)Let $A \subset B \subset X$, if $A \in \nu O(B)$ and $B \in RO(X)$, then $A \in \nu O(X)$.

Remark 1: $\nu GO(X, x)$[resp: RCO(X,x)] represents $\nu g-$open set containing x[resp: r-clopen set containing x].

Theorem 2.1:
(i) If f is νg.c., then f is al.νg.c.
(i) If f is c.νg.c., then f is al.c.νg.c.

3. Almost Slightly $\nu g-$Continuous Functions:

Definition 3.1: A function f:X$\to$ Y is said to be almost slightly $\nu g-$continuous function at $x \in X$ if for each $V \in RCO(Y, f(x)), \exists U \in \nu GO(X, x)$ such that $f(U) \subseteq V$ and almost slightly $\nu g-$continuous function if it is almost slightly $\nu g-$continuous at each $x \in X$.

Note 2: Here after we call almost slightly $\nu g-$continuous function as al.sl.$\nu g.c$ function shortly.

Example 3.1: $X = Y = \{a, b, c\}; \tau = \{\phi, \{a\}, \{b\}, \{a, b\}, X\}$ and $\sigma = \{\phi, \{a\}, \{b, c\}, Y\}$. Let f is identity function, then f is al.sl.$\nu g.c$.

Example 3.2: $X = Y = \{a, b, c, d\}; \tau = \sigma = \{\phi, \{a\}, \{b\}, \{d\}, \{a, b\}, \{a, d\}, \{b, d\}, \{a, b, c\}, \{a, b, d\}, X\}$. Let f be defined by $f(a) = b; f(b) = c; f(c) = d$ and $f(d) = a$, then f is not sl.$\nu g.c.$, and not al.sl.$\nu g.c.$ Since it is not satisfying the condition at the points c and d.

Theorem 3.1: The following are equivalent.
(i) f is al.sl.νg.c.
(ii) $f^{-1}(V)$ is $\nu g-$open for every r-clopen set V in Y.
(iii)$f^{-1}(V)$ is $\nu g-$closed for every r-clopen set V in Y.
(iv) $f(\nu g\overline{(A)}) \subseteq \nu g\overline{(f(A))}$.

Corollary 3.1: The following are equivalent.
(i) f is al.sl.νg.c.
(ii) For each $x \in X$ and each r-clopen subset $V \in (Y, f(x)) \exists U \in \nu GO(X, x) \ni f(U) \subseteq V$.
Proof: Strightforward from definition 3.1.

Theorem 3.2: Let $\Sigma = \{U_i : i \in I\}$ be any cover of X by regular open sets in X. A function f is al.sl.νg.c. iff $f_{/U_i}$: is al.sl.νg.c., for each $i \in I$.
Proof: Let $i \in I$ be an arbitrary index and $U_i \in RO(X)$. Let $x \in U_i$ and $V \in RCO(Y, f_{U_i}(x))$. For f is al.sl.νg.c, $\exists U \in \nu GO(X, x) \ni f(U) \subset V$. Since $U_i \in RO(X)$, by lemma 2.1 $x \in U \cap U_i \in \nu GO(U_i)$ and $(f_{/U_i})U \cap U_i = f(U \cap U_i) \subset f(U) \subset V$. Hence $f_{/U_i}$ is al.sl.νg.c.

Conversely Let $x \in X$ and $V \in RCO(Y, f(x))$, $\exists i \in I \ni x \in U_i$. Since $f_{/U_i}$ is al.sl.$\nu g.c$, $\exists U \in \nu GO(U_i, x) \ni f_{/U_i}(U) \subset V$. By lemma 2.1, $U \in \nu GO(X)$ and $f(U) \subset V$. Hence f is al.sl.νg.c.

Theorem 3.3:
(i) If f is $\nu g-$irresolute and g is al.sl.νg.c.[al.sl.c.], then $g \circ f$ is al.sl.νg.c.
(i) If f is $\nu g-$irresolute and g is al.νg.c., then $g \circ f$ is al.sl.νg.c.
(iii)If f is $\nu g-$continuous and g is al.sl.c., then $g \circ f$ is al.sl.νg.c.
(iv) If f is rg-continuous and g is al.sl.νg.c. [al.sl.c.], then $g \circ f$ is al.sl.νg.c.

Theorem 3.4: If f is $\nu g-$irresolute, $\nu g-$open and $\nu GO(X) = \tau$ and g be any function, then $g \circ f$ is al.sl.νg.c iff g is al.sl.νg.c.
Proof: If part: Theorem 3.3(i)
Only if part: Let A be r-clopen subset of Z. Then $(g \circ f)^{-1}(A)$ is a $\nu g-$open subset of X and hence open in X[by assumption]. Since f is $\nu g-$open $f(g \circ f)^{-1}(A) = g^{-1}(A)$ is $\nu g-$open in Y. Thus g is al.sl.νg.c.

Corollary 3.2: If f is $\nu g-$irresolute, $\nu g-$open and $\nu GO(X) = RO(X)$ and g be any function, then $g \circ f$ is al.sl.νg.c iff g is al.sl.νg.c.

Corollary 3.3: If f is $\nu g-$irresolute, $\nu g-$open and bijective, g is a function. Then g is al.sl.νg.c. iff $g \circ f$ is al.sl.νg.c.

Theorem 3.5: If $g : X \to X \times Y$, defined by $g(x) = (x, f(x)) \forall x \in X$ be the graph function of $f : X \to Y$. Then g is al.sl.$\nu g.c$ iff f is al.sl.$\nu g.c$.
Proof: Let $V \in RCO(Y)$, then $X \times V \in RCO(X \times Y)$. Since g is al.sl.νg.c., $f^{-1}(V) = f^{-1}(X \times V) \in \nu GO(X)$. Thus f is al.sl.νg.c.
Conversely, let $x \in X$ and $F \in RCO(X \times Y, g(x))$. Then $F \cap (\{x\} \times Y) \in RCO(\{x\} \times Y), g(x))$. Also $\{x\} \times Y$ is homeomorphic to Y. Hence $\{y \in Y : (x, y) \in F\} \in RCO(Y)$. Since f is al.sl.νg.c. $\bigcup\{f^{-1}(y) : (x, y) \in F\} \in \nu GO(X)$. Further $x \in \bigcup\{f^{-1}(y) : (x, y) \in F\} \subseteq g^{-1}(F)$. Hence $g^{-1}(F)$ is $\nu g-$open. Thus g is al.sl.νg.c.

Theorem 3.6:
(i) If $f : X \to \Pi Y_\lambda$ is al.sl.$\nu g.c$, then $P_\lambda \circ f : X \to Y_\lambda$ is al.sl.$\nu g.c$ for each $\lambda \in \Lambda$, where P_λ is the projection of ΠY_λ onto Y_λ.
(ii) $f : \Pi X_\lambda \to \Pi Y_\lambda$ is al.sl.$\nu g.c$, iff $f_\lambda : X_\lambda \to Y_\lambda$ is al.sl.$\nu g.c$ for each $\lambda \in \Lambda$.

Remark 2:
(i)Composition, Algebraic sum and product of al.sl.$\nu g.c$ functions is not in general al.sl.$\nu g.c$.
(iii)The pointwise limit of a sequence of al.sl.$\nu g.c$ functions is not in general al.sl.$\nu g.c$.

Example 3.3: Let X = Y = [0, 1]. Let $f_n : X \to Y$ is defined as follows $f_n(x) = x_n$ for n = 1, 2, 3, ..., then f defined by $f(x) = 0$ if $0 \leq x < 1$ and $f(x) = 1$ if x = 1. Therefore each f_n is al.sl.$\nu g.c$ but f is not al.sl.$\nu g.c$. For $(\frac{1}{2}, 1]$ is r-clopen in Y, but $f^{-1}((\frac{1}{2}, 1]) = \{1\}$ is not $\nu g-$open in X.

However we can prove the following:

Theorem 3.7: The uniform limit of a sequence of al.sl.$\nu g.c$ functions is al.sl.$\nu g.c$.

Note 3: Pasting lemma is not true for al.sl.$\nu g.c$ functions. However we have the following weaker versions.

Theorem 3.8: Let X and Y be topological spaces such that $X = A \cup B$ and let $f_{/A}$ and $g_{/B}$ are al.sl.r.c maps such that f(x) = g(x) $\forall x \in A \cap B$. If

$A, B \in RO(X)$ and RO(X) is closed under finite unions, then the combination $\alpha : X \to Y$ is al.sl.$\nu g.c$ continuous.

Theorem 3.9: Pasting lemma Let X and Y be spaces such that $X = A \cup B$ and let $f_{/A}$ and $g_{/B}$ are al.sl.$\nu g.c$ maps such that f(x) = g(x) $\forall x \in A \cap B$. If $A, B \in RO(X)$ and νGO(X) is closed under finite unions, then the combination $\alpha : X \to Y$ is al.sl.$\nu g.c.$
Proof: Let $F \in RCO(Y)$, then $\alpha^{-1}(F) = f^{-1}(F) \cup g^{-1}(F)$, where $f^{-1}(F) \in \nu GO(A)$ and $g^{-1}(F) \in \nu GO(B) \Rightarrow f^{-1}(F); g^{-1}(F) \in \nu GO(X) \Rightarrow f^{-1}(F) \cup g^{-1}(F) = \alpha^{-1}(F) \in \nu GO(X)$[by assumption]. Hence $\alpha : X \to Y$ is al.sl.$\nu g.c.$

4. Comparisons:

Theorem 4.1: If f is sl.νg.c., then f is al.sl.νg.c.
Proof: Let $x \in X$ and $V \in RCO(Y, f(x))$, then $x \in X$ and $V \in CO(Y, f(x))$. Since f is sl.νg.c., $\exists$ an $U \in \nu GO(X, x) \ni f(U) \subset V$. Hence f is al.sl.νg.c.

Theorem 4.2: If f is νg.c., then f is sl.νg.c.
Proof: Let $x \in X$ and $V \in CO(Y, f(x))$, then $x \in X$ and $V \in \sigma(Y, f(x))$. Since f is νg.c., $f^{-1}(V) \in \nu GO(X, x)$ i.e., $\exists$ an $U_x \in \nu GO(X, x) \ni U_x \subset f^{-1}(V)$ $\Rightarrow f(U_x) \subset V$. Hence f is sl.νg.c.

Theorem 4.3: If f is c.νg.c., then f is sl.νg.c.
Proof: Let $x \in X$ and $V \in CO(Y, f(x))$, then $x \in X$ and V is closed in Y containing $f(x)$. Since f is c.νg.c., $f^{-1}(V) \in \nu GO(X, x)$ i.e., $\exists$ an $U_x \in \nu GO(X, x)$ $\ni U_x \subset f^{-1}(V) \Rightarrow f(U_x) \subset V$. Hence f is sl.νg.c.

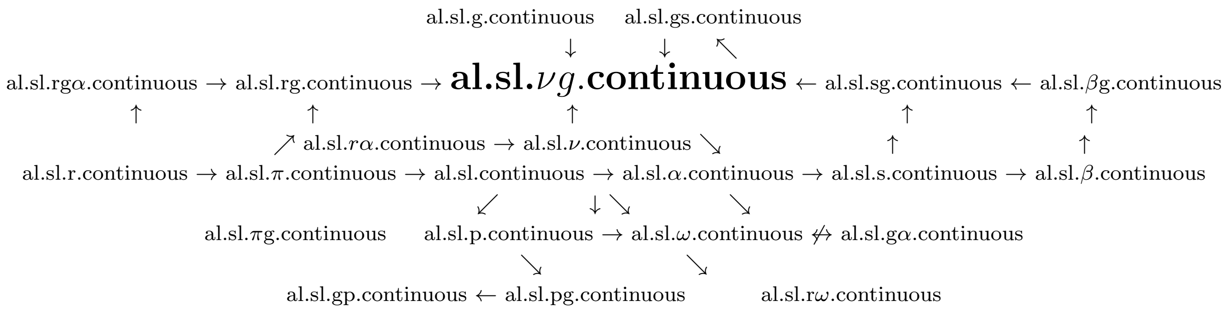
Theorem 4.4: If f is al.νg.c., then f is al.sl.νg.c.
Proof: Let $x \in X$ and $V \in RCO(Y, f(x))$, then $x \in X$ and $V \in \sigma(Y, f(x))$. Since f is al.νg.c., $f^{-1}(V) \in \nu GO(X, x)$ i.e., $\exists$ an $U_x \in \nu GO(X, x) \ni U_x \subset f^{-1}(V) \Rightarrow f(U_x) \subset V$. Hence f is sl.νg.c.

Theorem 4.5: If f is al.c.νg.c., then f is al.sl.νg.c.
Proof: Let $x \in X$ and $V \in RCO(Y, f(x))$, then $x \in X$ and V is closed in Y containing $f(x)$. Since f is al.c.νg.c., $f^{-1}(V) \in \nu GO(X, x)$ i.e., $\exists$ an $U_x \in \nu GO(X, x) \ni U_x \subset f^{-1}(V) \Rightarrow f(U_x) \subset V$. Hence f is sl.νg.c.

Theorem 4.6:
(i) If f is al.sl.rg.c, then f is al.sl.νg.c.
(ii) If f is al.sl.sg.c, then f is al.sl.νg.c.
(iii) If f is al.sl.g.c, then f is al.sl.νg.c.
(iv) If f is al.sl.s.c, then f is al.sl.νg.c.

(v) If f is al.sl.ν.c, then f is al.sl.νg.c.
(vi) If f is al.sl.r.c, then f is al.sl.νg.c.
(vii) If f is al.sl.c, then f is al.sl.νg.c.
(viii)If f is al.sl.ω.c, then f is al.sl.νg.c.
(ix) If f is al.sl.rgα.c, then f is al.sl.rg.c.
(x) If f is al.sl.ω-irresolute, then f is al.sl.νg.c.
(xi) If f is al.sl.r.ω.c, then f is al.sl.νg.c.
(xii) If f is al.sl.π.c, then f is al.sl.νg.c.
(xiii)If f is al.sl.α.c, then f is al.sl.νg.c.
(xiv) If f is al.sl.gα.c, then f is al.sl.νg.c.

Note 4: By note 1 and from the above theorem we have the following implication diagram.



Theorem 4.7:
(i) If RαO(X) = RO(X) then f is al.sl.rα.c. iff f is al.sl.r.c.
(ii) If νGO(X) = RαO(X) then f is al.sl.rα.c. iff f is al.sl.νg.c.
(iii)If νGO(X) = RO(X) then f is al.sl.rα.c. iff f is al.sl.νg.c.
(iv) If νGO(X) = αO(X) then f is al.sl.α.c. iff f is al.sl.νg.c.
(v) If νGO(X) = SO(X) then f is al.sl.s.c. iff f is al.sl.νg.c.
(vi) If νGO(X) = βO(X) then f is al.sl.β.c. iff f is al.sl.νg.c.

Theorem 4.8: If f is al.sl.νg.c., from a discrete space X into a e.d space Y, then f is w.s.c.
Proof: Follows from note 3 above and theorem 3[41] of T.M.Nour.

Corollary 4.1: If f is al.sl.νg.c., from a discrete space X into a e.d space Y, then:
(i) f is w.s.c.
(ii) f is w.β.c.
(iii)f is w.p.c.
Proof: Follows from note 3 above and theorem 4.8.

Theorem 4.9: If f is al.sl.νg.c., and X is discrete and e.d, then f is al.sl.c.

Proof: Let $x \in X$ and $V \in RCO(Y, f(x))$. Since f is al.sl.νg.c, $\exists U \in \nu GO(X, x) \ni f(U) \subset V \Rightarrow U \in SR(X, x) \ni f(U) \subset V$. Since X is discrete and e.d. $U \in CO(X)$. Hence f is al.sl.c.

Corollary 4.2: If f is al.sl.νg.c., and X is $\nu T_{\frac{1}{2}}$, discrete and e.d, then:
(i) f is al.sl.c.
(ii) f is al.sl.α.c.
(iii)f is al.sl.s.c.
(iv) f is al.sl.β.c.
(v) f is al.sl.p.c.
Proof: Follows from note 3 above and theorem 4.9.

Theorem 4.10: If f is al.sl.νg.c., from a discrete space X into a e.d space Y, then f st.θ.s.c.
Proof: Let $x \in X$ and $V \in \sigma(Y, f(x))$, then $s\overline{(V)} \subset (\overline{V})^o \in RO(Y)$. Since Y is e.d, $s\overline{(V)} \in CO(Y)$. Since f is al.sl.νg.c, f is al.sl.s.c, $\exists U \in SO(X, x) \ni f(s\overline{(U)}) \subset s\overline{(V)}$, so f is a.st.θ.s.c.

Theorem 4.11: If f is al.sl.νg.c from a discrete space X into a T_3 space Y, then f st.θ.s.c.
Proof: Let $x \in X$ and $V \in \sigma(Y, f(x))$. Since Y is Ultra regular, $\exists W \in CO(Y) \ni f(x) \in W \subset V$. Since f is al.sl.νg.c, $\exists U \in SO(X, x) \ni f(s\overline{(U)}) \subset W$ and $f(s\overline{(U)}) \subset V$. Thus f is st.θ.s.c.

Example 4.1: Example 3.1 above f is al.sl.$\nu g.c$; al.sl.sg.c; al.sl.gs.c; al.sl.rα.c; al.sl.ν.c; al.sl.s.c. and al.sl.β.c; but not al.sl.g.c; al.sl.rg.c; al.sl.gr.c; al.sl.pg.c; al.sl.gp.c; al.sl.gpr.c; al.sl.gα.c; al.sl.αg.c; al.sl.rgα.c; al.sl.r.c; al.sl.p.c; al.sl.α.c; and al.sl.c;

Example 4.2: Example 3.2 above f is al.sl.rα.c; and al.sl.gpr.c; but not al.sl.$\nu g.c$; al.sl.sg.c; al.sl.gs.c; al.sl.ν.c; al.sl.s.c; al.sl.β.c; al.sl.g.c; al.sl.rg.c; al.sl.gr.c; al.sl.pg.c; al.sl.gp.c; al.sl.gα.c; al.sl.αg.c; al.sl.rgα.c; al.sl.r.c; al.sl.p.c; al.sl.α.c; and al.sl.c;

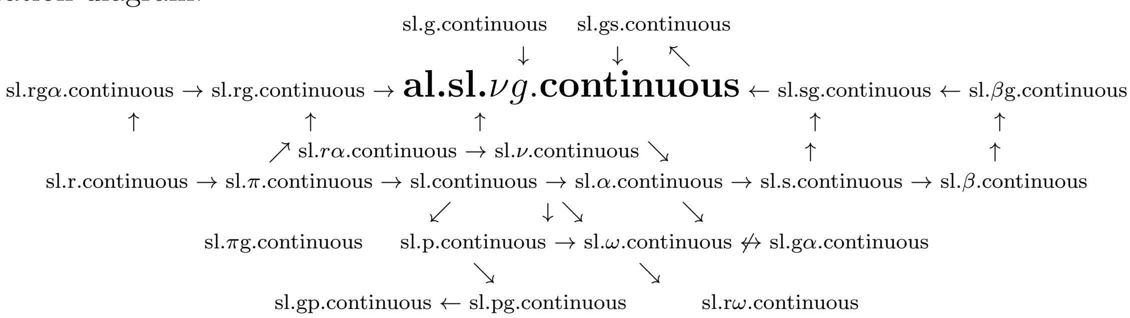
Remark 4.1: al.sl.rα.c; al.sl.gpr.c; and al.sl.νg.c. are independent to each other.

Example 4.3: Example 3.1 above f is al.sl.$\nu g.c$ and al.sl.rα.c; but not al.sl.gpr.c

Example 4.4: Example 3.2 above f is al.sl.rα.c; and al.sl.gpr.c; but not al.sl.$\nu g.c$

Theorem 4.12:
(i) If f is sl.rg.c, then f is al.sl.νg.c.
(ii) If f is sl.sg.c, then f is al.sl.νg.c.
(iii) If f is sl.g.c, then f is al.sl.νg.c.
(iv) If f is sl.s.c, then f is al.sl.νg.c.
(v) If f is sl.ν.c, then f is al.sl.νg.c.
(vi) If f is sl.r.c, then f is al.sl.νg.c.
(vii) If f is sl.c, then f is al.sl.νg.c.
(viii)If f is sl.ω.c, then f is al.sl.νg.c.
(ix) If f is sl.rgα.c, then f is al.sl.rg.c.
(x) If f is sl.ω-irresolute, then f is al.sl.νg.c.
(xi) If f is sl.r.ω.c, then f is al.sl.νg.c.
(xii) If f is sl.π.c, then f is al.sl.νg.c.
(xiii)If f is sl.α.c, then f is al.sl.νg.c.
(xiv) If f is sl.gα.c, then f is al.sl.νg.c.
Proof: Follows from Note 3[12] and above theorem.

Note 5: By note 1 and from the above theorem we have the following implication diagram.



5. Covering and Separation Properties:

Theorem 5.1: If f is al.sl.νg.c.[resp: al.sl.rg.c] surjection and X is $\nu g-$compact, then Y is compact.
Proof: Let $\{G_i : i \in I\}$ be any open cover for Y. Then each G_i is open in Y and hence each G_i is r-clopen in Y. Since f is al.sl.νg.c., $f^{-1}(G_i)$ is $\nu g-$open in X. Thus $\{f^{-1}(G_i)\}$ forms a $\nu g-$open cover for X and hence have a finite subcover, since X is $\nu g-$compact. Since f is surjection, $Y = f(X) = \bigcup_{i=1}^{n} G_i$. Therefore Y is compact.

Corollary 5.1: If f is al.sl.ν.c.[resp: al.sl.r.c] surjection and X is $\nu g-$compact, then Y is compact.

Theorem 5.2: If f is al.sl.νg.c., surjection and X is $\nu g-$compact[$\nu g-$lindeloff] then Y is mildly compact[mildly lindeloff].
Proof: Let $\{U_i : i \in I\}$ be r-clopen cover for Y. For each $x \in X, \exists \alpha_x \in I \ni f(x) \in U_{\alpha_x}$ and $\exists V_x \in \nu GO(X, x) \ni f(V_x) \subset U_{\alpha_x}$. Since the family $\{V_i : i \in I\}$ is a cover of X by $\nu g-$open sets of X, there exists a finite subset I_0 of $I \ni X \subset \{V_x : x \in I_0\}$. Therefore $Y \subset \bigcup\{f(V_x) : x \in I_0\} \subset \bigcup\{U_{\alpha_x} : x \in I_0\}$. Hence Y is mildly compact.

Corollary 5.2:
(i) If f is al.sl.rg.c[resp: al.sl.ν.c.; al.sl.r.c] surjection and X is $\nu g-$ compact [$\nu g-$ lindeloff] then Y is mildly compact [mildly lindeloff].
(ii) If f is al.sl.νg.c.[resp: al.sl.rg.c; al.sl.ν.c.; al.sl.r.c] surjection and X is locally $\nu g-$compact [resp:$\nu g-$Lindeloff; locally $\nu g-$lindeloff], then Y is locally compact[resp: Lindeloff; locally lindeloff].
(iii)If f is al.sl.νg.c.[al.sl.r.c.], surjection and X is locally $\nu g-$compact[resp: $\nu g-$lindeloff; locally $\nu g-$lindeloff] then Y is locally mildly compact{resp: locally mildly lindeloff}.

Theorem 5.3: If f is al.sl.νg.c., surjection and X is s-closed then Y is mildly compact[mildly lindeloff].
Proof: Let $\{V_i : V_i \in RCO(Y); i \in I\}$ be a cover of Y, then $\{f^{-1}(V_i) : i \in I\}$ is $\nu g-$open cover of X[by Thm 3.1] and so there is finite subset I_0 of I, such that $\{f^{-1}(V_i) : i \in I_0\}$ covers X. Therefore $\{(V_i) : i \in I_0\}$ covers Y since f is surjection. Hence Y is mildly compact.

Corollary 5.3: If f is al.sl.rg.c[resp: al.sl.ν.c.; al.sl.r.c.] surjection and X is s-closed then Y is mildly compact[mildly lindeloff].

Theorem 5.4: If f is al.sl.νg.c.,[resp: al.sl.rg.c.; al.sl.ν.c.; al.sl.r.c.] surjection and X is $\nu g-$connected, then Y is connected.
Proof: If Y is disconnected, then $Y = A \cup B$ where A and B are disjoint r-clopen sets in Y. Since f is al.sl.νg.c. surjection, $X = f^{-1}(Y) = f^{-1}(A) \cup f^{-1}(B)$ where $f^{-1}(A)$ $f^{-1}(B)$ are disjoint $\nu g-$open sets in X, which is a contradiction for X is $\nu g-$connected. Hence Y is connected.

Corollary 5.4: The inverse image of a disconnected space under a al.sl.νg.c.,[resp: al.sl.rg.c.; al.sl.ν.c.; al.sl.r.c.] surjection is $\nu g-$disconnected.

Theorem 5.5: If f is al.sl.νg.c.[resp: al.sl.rg.c.; al.sl.ν.c.], injection and Y is UT_i, then X is νg_i i = 0, 1, 2.
Proof: Let $x_1 \neq x_2 \in X$. Then $f(x_1) \neq f(x_2) \in Y$ since f is injective. For Y is $UT_2 \exists V_j \in RCO(Y) \ni f(x_j) \in V_j$ and $\cap V_j = \phi$ for j = 1,2. By Theorem 3.1,

$x_j \in f^{-1}(V_j) \in \nu GO(X)$ for j = 1,2 and $\cap f^{-1}(V_j) = \phi$ for j = 1,2. Thus X is νg_2.

Theorem 5.6: If f is al.sl.νg.c.[resp: al.sl.rg.c.; al.sl.ν.c.], injection; closed and Y is UT_i, then X is νgg_i i = 3, 4.
Proof:(i) Let $x \in X$ and F be disjoint closed subset of X not containing x, then $f(x)$ and $f(F)$ are disjoint closed subset of Y, since f is closed and injection. Since Y is ultraregular, $f(x)$ and $f(F)$ are separated by disjoint r-clopen sets U and V respectively. Hence $x \in f^{-1}(U)$; $F \subseteq f^{-1}(V)$, $f^{-1}(U); f^{-1}(V) \in \nu GO(X)$ and $f^{-1}(U) \cap f^{-1}(V) = \phi$. Thus X is νgg_3.

(ii) Let F_j and $f(F_j)$ are disjoint closed subsets of X and Y respectively for j = 1,2, since f is closed and injection. For Y is ultranormal, $f(F_j)$ are separated by disjoint r-clopen sets V_j respectively for j = 1,2. Hence $F_j \subseteq f^{-1}(V_j)$ and $f^{-1}(V_j) \in \nu GO(X)$ and $\cap f^{-1}(V_j) = \phi$ for j = 1,2. Thus X is νgg_4.

Theorem 5.7: If f is al.sl.νg.c.[resp: al.sl.rg.c.; al.sl.ν.c.], injection and
(i) Y is UC_i[resp: UD_i] then X is νgC_i[resp: νgD_i] i = 0, 1, 2.
(ii)Y is UR_i, then X is νgR_i i = 0, 1.

Theorem 5.8: If f is al.sl.νg.c.[resp: al.sl.ν.c.; al.sl.rg.c; al.sl.r.c] and Y is UT_2, then the graph G(f) of f is $\nu g-$closed in the product space $X \times Y$.
Proof: Let $(x_1, x_2) \notin G(f) \Rightarrow y \neq f(x) \Rightarrow \exists$ disjoint r-clopen sets V and W $\ni f(x) \in V$ and y$\in W$. Since f is al.sl.νg.c., $\exists U \in \nu GO(X) \ni x \in U$ and $f(U) \subset W$. Therefore $(x, y) \in U \times V \subset X \times Y - G(f)$. Hence G($f$) is $\nu g-$closed in $X \times Y$.

Theorem 5.9: If f is al.sl.νg.c.[resp: al.sl.ν.c.; al.sl.rg.c; al.sl.r.c] and Y is UT_2, then $A = \{(x_1, x_2)|f(x_1) = f(x_2)\}$ is $\nu g-$closed in the product space $X \times X$.
Proof: If $(x_1, x_2) \in X \times X - A$, then $f(x_1) \neq f(x_2) \Rightarrow \exists$ disjoint $V_j \in RCO(Y) \ni f(x_j) \in V_j$, and since f is al.sl.νg.c., $f^{-1}(V_j) \in \nu GO(X, x_j)$ for each j = 1,2. Thus $(x_1, x_2) \in f^{-1}(V_1) \times f^{-1}(V_2) \in \nu GO(X \times X)$ and $f^{-1}(V_1) \times f^{-1}(V_2) \subset X \times X - A$. Hence A is $\nu g-$closed.

Theorem 5.10: If f is al.sl.r.c.[resp: al.sl.c.]; g is al.sl.νg.c[resp: al.sl.rg.c; al.sl.ν.c]; and Y is UT_2, then $E = \{x \in X : f(x) = g(x)\}$ is $\nu g-$closed in X.

Conclusion: In this paper we defined almost slightly-$\nu g-$continuous functions, studied its properties and their interrelations with other types of almost slightly-continuous functions.

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