##### Quadripartitioned single valued neutrosophic refined contra Generalized pre continuous mappings

**Arokia Pratheesha S V 1 and Mohana K 2**

1 Research Scholar, Nirmala College for Women, Coimbatore; pratheesha555@gmail.com

 2 Assistant Professor, Nirmala College for Women, Coimbatore; riyaraju1116@gmail.com

**Abstract:** The focus of this paper is to introduce and study the notions of quadripartitioned single valued neutrosophic refined contra generalized pre-continuous mappings in quadripartitioned single valued neutrosophic refined topological spaces.We examine some of its basic characteristics and properties.

**Keywords:**Quadripartitioned single valued neutrosophic refined topology,QNRCGP-conti.mapping,QNRC-conti.mapping,QNRCG-closed set.

## 1 Introduction

L.A. Zadeh [9]was the first to explain fuzzy sets and fuzzy set operations. Fuzzy topological spaces were first introduced and developed by Chang [4]. The earliest publication of the "Intuitionistic fuzzy set" notion was made by Atanassov [1].Fuzzy sets and neurothosophic sets, an expansion of intuitionistic fuzzy sets, were first described by Smarandache[6]. Neutosophic set theory addresses the problem of uncertainty. As an extension of intuitionistic fuzzy sets, fuzzy sets, and the classical set, Wang [7] proposed single-valued neutrosphic sets.Four membership functions make up Chatterjee’s quadripartitioned single valued neutrosophic sets: truth, contradiction, unknown, and falsity. Deli et al.’s [5] development of intuitionistic fuzzy multisets and fuzzy multisets was the introduction of neurosophic refined sets.This paper is arranged in the following manner:Section 2 consists of basic concepts.Section 3 consists of quadripartitioned single valued neutrosophic refined contra generalized pre continuous mapping and its characterizations.

## 2 Preliminaries

**Definition 2.1** *[2] A QSVNRS* $ϱ$ *on* $Λ$ *can be defined by* $ϱ$ *={*$〈κ$*,*$T\_{ϱ}^{J}(κ),D\_{ϱ}^{J}(κ),Y\_{ϱ}^{J}(κ),F\_{ϱ}^{J}(κ)〉$*:*$κ\in Λ$*}*

where$T\_{ϱ}^{J}(κ),D\_{ϱ}^{J}(κ),Y\_{ϱ}^{J}(κ),F\_{ϱ}^{J}(κ)$:$Λ\rightarrow $[0,1] such that 0$\leq T\_{ϱ}^{J}$+$D\_{ϱ}^{J}$+$Y\_{ϱ}^{J}$+$F\_{ϱ}^{J}\leq $4 (J=1,2,...P) and for every $κ\in Λ$.$T\_{ϱ}^{J}(κ),D\_{ϱ}^{J}(κ),Y\_{ϱ}^{J}(κ)andF\_{ϱ}^{J}(κ)$ are the truth membership sequence,a contradiction membership sequence,an unknown membership sequence and falsity membership sequence of the element x respectively. P is also referred to as the QSVNRS($ϱ$) dimension.

**Definition 2.2** *[2] Let* $ϱ$*,* $ζ$$\in $ *QSVNRS(*$Λ$*) havimg the form*

$ϱ$ ={$〈κ$,$T\_{ϱ}^{J}(κ),D\_{ϱ}^{J}(κ),Y\_{ϱ}^{J}(κ),F\_{ϱ}^{J}(κ)〉$:$κ\in Λ$} (J=1,2,...P)

$ζ$ ={$〈κ$,$T\_{ζ}^{J}(κ),D\_{ζ}^{J}(κ),Y\_{ζ}^{J}(κ),F\_{ζ}^{J}(κ)〉$:$κ\in Λ$} (J=1,2,...P).Then

1. $ϱ$ $\tilde{⊆}$ $ζ$ if $T\_{ϱ}^{J}(κ)$ $\leq $ $T\_{ζ}^{J}(κ)$, $D\_{ϱ}^{J}(κ)$ $\leq $ $D\_{ζ}^{J}(κ)$, $Y\_{ϱ}^{J}(κ)$ $\leq $ $Y\_{ζ}^{J}(κ)$ and $F\_{ϱ}^{J}(κ)$ $\leq $ $F\_{ζ}^{J}(κ)$ J=1,2,...P)

2. $ϱ^{\tilde{c}}$ ={$〈κ$,$F\_{ϱ}^{J}(κ),Y\_{ϱ}^{J}(κ),D\_{ϱ}^{J}(κ),T\_{ϱ}^{J}(κ)〉$:$κ\in Λ$} (J=1,2,...P)

3.$ϱ$ $\tilde{∪}$ $ζ$ = $ω\_{1}$ and is defined by

$T\_{ω\_{1}}^{J}(κ)$=max{$T\_{ϱ}^{J}(κ)$,$T\_{ζ}^{J}(κ)$}, $D\_{ω\_{1}}^{J}(κ)$=max{$D\_{ϱ}^{J}(κ)$,$D\_{ζ}^{J}(κ)$}, $Y\_{ω\_{1}}^{J}(κ)$=min{$Y\_{ϱ}^{J}(κ)$,$Y\_{ζ}^{J}(κ)$}, $F\_{ω\_{1}}^{J}(κ)$=min{$F\_{ϱ}^{J}(κ)$,$F\_{ζ}^{J}(κ)$} for all $κ$ $\in $ $Λ$ and J=1,2...P.

4. $ϱ$ $\tilde{∩}$ $ζ$ = $ω\_{1}$ and is defined by

$T\_{ω\_{1}}^{J}(κ)$=min{$T\_{ϱ}^{J}(κ)$,$T\_{ζ}^{J}(κ)$}, $D\_{ω\_{1}}^{J}(κ)$=min{$D\_{ϱ}^{J}(κ)$,$D\_{ζ}^{J}(κ)$}, $Y\_{ω\_{1}}^{J}(κ)$=max{$Y\_{ϱ}^{J}(κ)$,$Y\_{ζ}^{J}(κ)$}, $F\_{ω\_{1}}^{J}(κ)$=max{$F\_{ϱ}^{J}(κ)$,$F\_{ζ}^{J}(κ)$} for all $κ$ $\in $ $Λ$ and J=1,2...P.

**Definition 2.3** *[2] A QSVNRTS on* $Λ^{\*}$ *in a family* $T$ *of QSVNRS in* $Λ^{\*}$ *which satisfy the following axioms.*

1. $\tilde{Φ}\_{QNR}$ , $\tilde{X}\_{QNR}$ $\in $ $T$.

2. $H\_{1}\tilde{∩}$ $H\_{2}$ $\in $ $T$ for any $H\_{1}$, $H\_{2}$ $\in $ $T$.

3. $\tilde{∪}$ $H\_{i}$ $\in $ $T$ for every{ $H\_{i}$ : i $\in $ I}$\tilde{⊆}$ $T$.

Here the pair ($Λ^{\*}$,$T$) is called a QSVNRTS and any QSVNRS in $T$ is said to be quadripartitioned single valued neutrosophic refined open set (QNROS) in $Λ^{\*}$. The complement of $ϱ^{\tilde{c}}$ of a QNROS $ϱ$ in a QSVNRTS ($Λ^{\*}$,$T$) is known as quadripartitioned single valued neutrosophic refined closed set (QNRCS) in $Λ^{\*}$.

**Definition 2.4** *[2] Let (*$Λ^{\*}$*,*$T$*) be a QSVNRTS and* $ϱ$ *={*$〈κ$*,*$T\_{ϱ}^{J}(κ),D\_{ϱ}^{J}(κ),Y\_{ϱ}^{J}(κ),F\_{ϱ}^{J}(κ)〉$*:*$κ\in Λ^{\*}$*} for J=1,2,...P be QSVNRS in X.Then quadripartitioned single valued neutrosophic refined closure (QNR(*$cl(ϱ)$*) and quadripartitioned single valued neutrosophic refined interior (QNR*$int(ϱ)$*) are defined by*

 QNR$cl(ϱ)$ = $\tilde{∩}${K:K is a QNRCS in $X$ and $ϱ$ $\tilde{⊆}$ K}

 QNR$int(ϱ)$= $\tilde{∪}${L:L is a QNROS in $X$ and L $\tilde{⊆}$ $ϱ$}

**Definition 2.5** *[2] Let (*$Λ^{\*}$*,*$T$*) be a QSVNRTS is known as*

1.Quadripartitioned single valued neutrosophic refined semi closed set(QNRSCS) if QNRint(QNRcl($ϱ$)) $\tilde{⊆}$ $ϱ$.

2.Quadripartitioned single valued neutrosophic refined pre-closed set(QNRPCS) if QNRcl(QNRint($ϱ$)) $\tilde{⊆}$ $ϱ$.

3.Quadripartitioned single valued neutrosophic refined $α$-closed set(QNR$α$CS) if QNRcl(QNRint(QNRcl($ϱ$))) $\tilde{⊆}$ $ϱ$.

4.Quadripartitioned single valued neutrosophic refined regular closed (QNRRCS) if $ϱ$ = QNRcl(QNRint($ϱ$)).

5.Quadripartitioned single valued neutrosophic refined semi-pre closed set(QNRSPCS) if QNRint(QNRcl(QNRint($ϱ$))) $\tilde{⊆}$ $ϱ$.

**Definition 2.6** *[2] Let (*$Λ^{\*}$*,*$T$*) be a QSVNRTS is known as*

1.generalized closed set (QNRGCS) if QNRcl($ϱ$) $\tilde{⊆}$ L whenever $ϱ$ $\tilde{⊆}$ L and L is a QNROS in $Λ^{\*}$.

2.generalized pre closed set (QNRGPCS) if QNRPcl($ϱ$) $\tilde{⊆}$ L whenever $ϱ$ $\tilde{⊆}$ L and L is a QNROS in $Λ^{\*}$.

3.generalized semi closed set (QNRGSCS) if QNRScl($ϱ$) $\tilde{⊆}$ L whenever $ϱ$ $\tilde{⊆}$ L and L is a QNROS in $Λ^{\*}$.

4.generalized $α$ closed set (QNRG$α$CS) if QNR$α$cl($ϱ$) $\tilde{⊆}$ L whenever $ϱ$ $\tilde{⊆}$ L and L is a QNROS in $Λ^{\*}$.

5.generalized semi-pre closed set (QNRGSPCS) if QNRSPcl($ϱ$) $\tilde{⊆}$ L whenever $ϱ$ $\tilde{⊆}$ L and L is a QNROS in $Λ^{\*}$.

**Definition 2.7** *[3] Let (*$ω^{\*}$*,*$Λ$*) and (*$κ^{\*}$*,*$Γ$*) be any two QSVNRTS. A map* $δ:$*(*$ω^{\*}$*,*$Λ$*)* $\rightarrow $ *(*$κ^{\*}$*,*$Γ$*) is known as,*

• Quadripartitioned single valued neutrosophic refined continuous (QNR conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNRCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined semi-continuous (QNRS conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNRSCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined pre-continuous (QNRP conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNRPCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined semi pre-continuous (QNRSP conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNRSPCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined $α$-continuous (QNR$α$-conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNR$α$CS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined regular continuous (QNRR conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNRRCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined generalized continuous (QNRG conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNRGCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined generalized semi continuous (QNRGS conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNRGSCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined generalized semi pre-continuous (QNRGSP conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNRGSPCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

• Quadripartitioned single valued neutrosophic refined $α$ generalized-continuous (QNR$α$G conti) if $δ^{-1}$($ξ\_{Q1}$) $\in $ QNR$α$GCS($ω^{\*}$) for all QNRCS $ξ\_{Q1}$ of ($κ^{\*}$,$Γ$).

## 3 Quadripartitioned single valued neutrosophic refined contra generalized continuous mappings

**Definition 3.1** *A map* $δ$ *: (A,*$τ$*)* $\rightarrow $ *(B,*$κ$*) is known as Quadripartitioned single valued neutrosophic refined contra generalized continuous(QNRCGP-conti)mapping if* $δ^{-1}$*(*$ζ$*) is a QNRGPCS in (A,*$τ$*) for every QNROS* $ζ$ *in (B,*$κ$*).*

**Example 3.2** *Let A = {e,f} and B = {w,x}*

$U\_{1}$={$〈$e,{0.4,0.6,0.7,0.8},{0.5,0.6,0.8,0.3},{0.5,0.7,0.3,0.4}$〉$,

 $〈$f,{0.6,0.7,0.4,0.5},{0.7,0.8,0.5,0.6}, {0.8,0.6,0.5,0.7}$〉$}

$U\_{2}$={$〈$w,{0.6,0.8,0.2,0.3},{0.7,0.8,0.3,0.5},{0.6,0.5,0.4,0.3}$〉$,

$ 〈$x,{0.8,0.7,0.4,0.6},{0.6,0.5,0.4,0.3}, {0.7,0.6,0.3,0.5}$〉$}

Then $τ$ = {$0\_{QNR}$,$1\_{QNR}$, $U\_{1}$} and $κ$ = {$0\_{QNR}$,$1\_{QNR}$, $U\_{2}$} are QSVNRTS on A and B.Define a mapping $δ$ : (A,$τ$) $\rightarrow $ (B,$κ$) by $δ$(e) = w and $δ$(f) = x.Then $δ$ is QNRCGP-conti.mapping.

**Theorem 3.3** *Every QNRC-conti.mapping is a QNRCGP-conti.mapping but not conversely.*

*Proof.* Let $δ$ : (A,$τ$) $\rightarrow $ (B,$κ$) be a QNRC-conti.mapping.Let $ζ$ be a QNROS in B.Then $δ^{-1}$($ζ$) is a QNRCS in A.Since every QNRCS is a QNRGPCS,$δ^{-1}$($ζ$) is a QNRGPCS in A.Hence $δ$ is a QNRCGP-conti.mapping.

**Example 3.4** *Let A = {e,f} and B = {w,x}*

$U\_{1}$={$〈$e,{0.4,0.3,0.6,0.5},{0.6,0.5,0.8,0.7},{0.5,0.3,0.6,0.8}$〉$,

 $〈$f,{0.5,0.4,0.7,0.6},{0.3,0.4,0.7,0.5}, {0.6,0.4,0.8,0.7}$〉$}

$U\_{2}$={$〈$w,{0.5,0.6,0.3,0.4},{0.4,0.3,0.5,0.6},{0.6,0.5,0.5,0.7}$〉$,

 $〈$x,{0.4,0.3,0.6,0.5},{0.8,0.7,0.6,0.4}, {0.5,0.6,0.7,0.6}$〉$}

Then $τ$ = {$0\_{QNR}$,$1\_{QNR}$, $U\_{1}$} and $κ$ = {$0\_{QNR}$,$1\_{QNR}$, $U\_{2}$} are QSVNRTS on A and B.Define a mapping $δ$ : (A,$τ$) $\rightarrow $ (B,$κ$) by $δ$(e) = w and $δ$(f) = x.Then $δ$ is QNRCGP-conti.mapping but not QNRC-conti.mapping.

**Theorem 3.5** *Every QNRC*$α$*-conti.mapping is a QNRCGP-conti.mapping but not conversely.*

*Proof.* Let $δ$ : (A,$τ$) $\rightarrow $ (B,$κ$) be a QNRC$α$-conti.mapping.Let $ζ$ be a QNROS in B.Then $δ^{-1}$($ζ$) is a QNR$α$CS in A.Since every QNR$α$CS is a QNRGPCS,$δ^{-1}$($ζ$) is a QNRGPCS in A.Hence $δ$ is a QNRCGP-conti.mapping.

**Example 3.6** *Let A = {e,f} and B = {w,x}*

$U\_{1}$={$〈$e,{0.3,0.4,0.7,0.6},{0.4,0.5,0.7,0.8},{0.4,0.5,0.6,0.7}$〉$,

 $〈$f,{0.4,0.5,0.8,0.7},{0.3,0.4,0.6,0.8}, {0.6,0.5,0.7,0.8}$〉$}

$U\_{2}$={$〈$w,{0.5,0.6,0.6,0.5},{0.5,0.7,0.6,0.7},{0.5,0.6,0.6,0.5}$〉$,

 $〈$x,{0.6,0.7,0.7,0.6},{0.4,0.5,0.6,0.7}, {0.7,0.5,0.6,0.7}$〉$}

Then $τ$ = {$0\_{QNR}$,$1\_{QNR}$, $U\_{1}$} and $κ$ = {$0\_{QNR}$,$1\_{QNR}$, $U\_{2}$} are QSVNRTS on A and B.Define a mapping $δ$ : (A,$τ$) $\rightarrow $ (B,$κ$) by $δ$(e) = w and $δ$(f) = x.Then $δ$ is QNRCGP-conti.mapping but not QNRC$α$-conti.mapping.

**Theorem 3.7** *Every QNRCP-conti.mapping is a QNRCGP-conti.mapping but not conversely.*

*Proof.* Let $δ$ : (A,$τ$) $\rightarrow $ (B,$κ$) be a QNRCP-conti.mapping.Let $ζ$ be a QNROS in B.Then $δ^{-1}$($ζ$) is a QNRPCS in A.Since every QNRPCS is a QNRGPCS,$δ^{-1}$($ζ$) is a QNRGPCS in A.Hence $δ$ is a QNRCGP-conti.mapping.

**Example 3.8** *Let A = {e,f} and B = {w,x}*

$U\_{1}$={$〈$e,{0.6,0.5,0.8,0.7},{0.4,0.3,0.5,0.6},{0.5,0.4,0.5,0.7}$〉$,

 $〈$f,{0.4,0.3,0.5,0.8},{0.5,0.6,0.8,0.9}, {0.4,0.5,0.8,0.7}$〉$}

$U\_{2}$={$〈$w,{0.7,0.8,0.7,0.6},{0.6,0.5,0.3,0.4},{0.6,0.4,0.4,0.6}$〉$,

 $〈$x,{0.7,0.5,0.3,0.6},{0.6,0.7,0.7,0.8}, {0.7,0.6,0.5,0.6}$〉$}

Then $τ$ = {$0\_{QNR}$,$1\_{QNR}$, $U\_{1}$} and $κ$ = {$0\_{QNR}$,$1\_{QNR}$, $U\_{2}$} are QSVNRTS on A and B.Define a mapping $δ$ : (A,$τ$) $\rightarrow $ (B,$κ$) by $δ$(e) = w and $δ$(f) = x.Then $δ$ is QNRCGP-conti.mapping but not QNRCP-conti.mapping.

**Theorem 3.9** *Let* $δ$ *: (A,*$τ$*)* $\rightarrow $ *(B,*$κ$*) be a mapping.Then the following conditions are equivalent.*

1.$δ$ is a QNRCGP-conti.mapping.

2.$δ^{-1}$($ζ$) is a QNRGPOS in A for every QNRCS in B.

*Proof.* 1) $⇒$ 2):Let $ζ$ be a QNRCS in B.Then $ζ^{\tilde{c}}$ is a QNROS in B.By statement,$δ^{-1}$($ζ^{\tilde{c}}$) is a QNRGPCS in A.Hence $δ^{-1}$($ζ$) is a QNRGPOS in A.

2) $⇒$ 1):Let $ζ$ be a QNROS in B.Then $ζ^{\tilde{c}}$ is a QNRCS in B.By statement,$δ^{-1}$($ζ^{\tilde{c}}$) is a QNRGPOS in A.Hence $δ^{-1}$($ζ$) is a QNRGPCS in A.Thus $δ$ is a QNRCGP-conti.mapping.

**Theorem 3.10** *Let* $δ$ *: (A,*$τ$*)* $\rightarrow $ *(B,*$κ$*) is a QNRCGP-conti.mapping if* $δ^{-1}$*(QNRPcl(*$ζ$*))*$\tilde{⊆}$*QNRint(*$δ^{-1}$*(*$ζ$*)) for every* $ζ$ *in B.*

*Proof.* Let $ζ$ be a QNRCS in B.Then QNRcl($ζ$) = $ζ$.Since every QNRCS is a QNRPCS,this implies QNRPcl($ζ$) = $ζ$.By hypothesis,$δ^{-1}$($ζ$) = $δ^{-1}$(QNRPcl($ζ$))$\tilde{⊆}$ QNRint($δ^{-1}$($ζ$))$\tilde{⊆}$ $δ^{-1}$($ζ$).This implies $δ^{-1}$($ζ$) is a QNROS in A.Therefore $δ$ is a QNRC-conti.mapping,since every QNRC-conti.mapping is a QNRCGP-conti.mapping,$δ$ is a QNRCGP-conti.mapping.

**Theorem 3.11** *A QNR-conti.mapping* $δ$ *: (A,*$τ$*)* $\rightarrow $ *(B,*$κ$*) is a QNRCGP-conti.mapping if QNRGPO(A) = QNRGPC(A).*

*Proof.* Let $ζ$ be a QNROS in Y.By hypothesis $δ^{-1}$($ζ$) is a QNROS in A and hence is a QNRGPOS in A.since QNRGPO(A) = QNRGPC(A),$δ^{-1}$($ζ$) is a QNRGPCS in A.Therefore $δ$ is a QNRCGP-conti.mapping.

## 4 Conclusion

In this paper,we introduced uadripartitioned single valued neutrosophic refined contra generalized pre-continuous mappings and some of this characterizations.

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