##### Quadripartitioned Single Valued Neutrosophic Refined Volterra Spaces

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**Abstract:** The focus of this paper is to present the concepts of quadripartitioned single valued neutrosophic refined volterra spaces and to investigate their characteristics. The ideas discussed in this paper are illustrated using a few examples.

**Keywords:**Quadripartitioned single valued neutrosophic refined nowhere dense, Quadripartitioned single valued neutrosophic refined -set,Quadripartitioned single valued neutrosophic refined -set, Quadripartitioned single valued neutrosophic refined volterra spaces.

## 1 Introduction

L.A. Zadeh [19]was the first to explain fuzzy sets and fuzzy set operations. Fuzzy topological spaces were first introduced and developed by Chang [5]. 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[12]. Neutosophic set theory addresses the problem of uncertainty. As an extension of intuitionistic fuzzy sets, fuzzy sets, and the classical set, Wang [17] 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 [6] development of intuitionistic fuzzy multisets and fuzzy multisets was the introduction of neurosophic refined sets.The concept of Volterra spaces has been thoroughly studied in classical topology [4,7,8,9].Thangaraj and Soundararajan[15] introduce and research the idea of fuzzy Volterra space.By Soundararajan, Rizwan, and Syed Tahir Hussainy [14], the idea of intuitionistic fuzzy Volterra space was first suggested and researched.This paper is arranged as follows: quadripartitioned single valued neutrosophic refined nowhere dense set , quadripartitioned single valued neutrosophic refined volterra space and its characteristics is present and some results are made about the functions that preserve this context of images and preimages.

## 2 Preliminaries

**Definition 2.1** [2] A QSVNRS on can be defined by

={,:}

where:[0,1] such that 0+++4 (J=1,2,...P) and for every . 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() dimension.

**Definition 2.2** [2] Let , QSVNRS() havimg the form

={,:} (J=1,2,...P)

={,:} (J=1,2,...P).Then

1. if , , and (J=1,2,...P)

2. ={,:} (J=1,2,...P)

3. = and is defined by

=max{,}, =max{,}, =min{,}, =min{,} for all and J=1,2...P.

4. = and is defined by

=min{,}, =min{,}, =max{,}, =max{,} for all and J=1,2...P.

**Definition 2.3** [2] A QSVNRTS on in a family of QSVNRS in which satisfy the following axioms.

1. , .

2. for any , .

3. for every{ : i I} .

Here the pair (,) is called a QSVNRTS and any QSVNRS in is said to be quadripartitioned single valued neutrosophic refined open set (QNROS) in . The complement of of a QNROS in a QSVNRTS (,) is known as quadripartitioned single valued neutrosophic refined closed set (QNRCS) in .

## 3 Quadripartitioned Single Valued Neutrosophic Refined Volterra Spaces

**Definition 3.1** *A QSVNRS in a QSVNRTS (,) is said to be QSVNR dense if there exists no QNRCS in (,) such that .*

**Definition 3.2** *A QSVNRS in a QSVNRTS (,) is said to be QSVNR nowhere dense set if there exists no QNROS in (,) such that QNR().That is QNR(QNR()) = .*

**Proposition 3.3** *Let be a QSVNRS.If is a QNRCS in (,) with QNR() = , then is a QSVNR nowhere dense in (,).*

*Proof.* Let is a QNRCS in (,). Then QNR() = . Now QNR(QNR()) = QNR() = and hence is a QSVNR nowhere dense in (,).

**Proposition 3.4** *Let be a QNRCS in (,),then U is a QSVNR nowhere dense set in (,) iff QNR(U) = .*

*Proof.* Let be a QNRCS in (,), with QNR() = . Then by Proposition 3.3, be QSVNR nowhere dense set (,). Conversely,Let is a QSVNR nowhere dense set in (,).we have QNR(QNR()) = implies that QNR() = .Since is a QNRCS,QNR(U) = .

**Proposition 3.5** *If is a QSVNR dense and QNROS in (,),then is a QSVNR nowheredense set in (,).*

*Proof.* Let is a QNROS in (,),we have QNR() = . Now QNR(QNR()) = (QNR(QNR( = (QNR()) = . Hence is a QSVNR nowheredense set in (,).

**Proposition 3.6** *If be a QSVNR nowhere dense set in (,), then QNR() is also a QSVNR nowhere dense set in (,).*

*Proof.* Let QNR( )=.Now QNR(QNR()) = QNR(QNR(QNR())) = QNR(QNR()) = . Hence = QNR() is a QSVNR nowheredense set in (,).

**Definition 3.7** *A QSVNRS in QSVNRTS (,) is said to be QSVNR -set in (,) if = where are QNROS in (,).*

**Definition 3.8** *A QSVNRS in a QSVNRTS (,) is known as QSVNR -set in (,) if = where are QNRCS in (,).*

**Definition 3.9** *A QSVNRTS (,) is said to be QSVNR first category set if = where ’s are QSVNR nowhere dense sets in (,).Otherwise (,) is known as QSVNR second category.*

**Definition 3.10** *A QSVNRTS (,) is known as Baire space if QNR()= , where ’s are QSVNR nowhere dense sets in (,).*

**Definition 3.11** *A QSVNRTS (,) is known as QSVNR volterra space if QNR() = , Here ’s are QSVNR dense and QSVNR -sets in (,).*

**Example 3.12** *Let ={}. Define the QSVNRS , , and as follows*

={,{0.5,0.3,0.4,0.2},{0.8,0.5,0.6,0.3},{0.5,0.3,0.2,0.4},

,{0.2,0.4,0.3,0.1},{0.3,0.5,0.2,0.4}, {0.4,0.2,0.3,0.5}}

={,{0.4,0.5,0.2,0.1},{0.7,0.9,0.4,0.5},{0.6,0.4,0.3,0.5},

,{0.5,0.6,0.2,0.3},{0.1,0.6,0.3,0.2}, {0.5,0.1,0.2,0.6}}

={,{0.5,0.5,0.2,0.1},{0.8,0.9,0.4,0.3},{0.6,0.4,0.2,0.4},

,{0.5,0.6,0.2,0.1},{0.3,0.6,0.2,0.2}, {0.5,0.2,0.2,0.5}}

={,{0.4,0.3,0.4,0.2},{0.7,0.5,0.6,0.5},{0.5,0.3,0.3,0.5},

,{0.2,0.4,0.3,0.3},{0.1,0.5,0.3,0.4}, {0.4,0.1,0.3,0.6}}

Then = { , , , , , } is a QSVNRT on .Thus (,) is a QSVNRTS.

Let = { ( )}, = { ( )}, = { ( ) ( )},

where , , are QSVNR -set in (,) and QNR() = , QNR() = , QNR() = .Then QNR( ) = . Hence (,) is a QSVNR volterra space.

**Example 3.13** *Let ={}. Define the QSVNRS , , and as follows*

={ ,{0.5,0.4,0.3,0.6},{0.2,0.7,0.4,0.3},{0.4,0.5,0.3,0.6},

,{0.6,0.5,0.4,0.7},{0.5,0.6,0.3,0.6}, {0.5,0.3,0.4,0.6}}

={,{0.7,0.3,0.4,0.2},{0.8,0.3,0.9,0.2},{0.5,0.2,0.6,0.1},

,{0.7,0.4,0.5,0.6},{0.4,0.3,0.7,0.2}, {0.2,0.7,0.7,0.2}}

={,{0.7,0.4,0.3,0.2},{0.8,0.7,0.4,0.2},{0.5,0.5,0.3,0.1},

,{0.7,0.5,0.4,0.6},{0.5,0.6,0.3,0.2}, {0.5,0.7,0.4,0.2}}

={,{0.5,0.3,0.4,0.6},{0.2,0.3,0.9,0.3},{0.4,0.2,0.6,0.6},

,{0.6,0.4,0.5,0.7},{0.4,0.3,0.7,0.6}, {0.2,0.3,0.7,0.6}}

Then = { , ,, , , } is a QSVNRT on .Thus (,) is a QSVNRTS. But there is no QSVNR -set in (,). Hence (,) is not a QSVNR volterra space.

**Proposition 3.14** *If = , where are QSVNR dense and QSVNR -sets in QSVNR volterra space (,), then is not a QNRCS.*

*Proof.* Let = , where ’s are QSVNR dense and QSVNR sets in (,). Since (,) is a QSVNR volterra space, we have QNR() = .(i.e.,) QNR() = which implies that QNR() . Therefore is not a QNRCS in (,).

**Proposition 3.15** *A QSVNRTS (,) is a QSVNR volterra space, iff QNR() = , where ’s are QSVNR dense and QSVNR -sets in (,).*

*Proof.* Let (,) be a QSVNR volterra space and ’s are QSVNR dense and QSVNR -sets in (,). Then we have QNR() = . Now QNR( = (QNR( = .

Conversely let QNR() = ,where ’s are QSVNR dense and QSVNR -sets in (,).Then QNR( = , this implis that (QNR( = .Therefore (,) is a QSVNR volterra space.

**Proposition 3.16** *Let (,) be a QSVNRTS. If QNR() = , ’s are QSVNR nowhere dense and QSVNR sets in (,), then (,) is a QSVNR volterra space.*

*Proof.* Let QNR() = , which implies (QNR()) = (i.e.,) QNR() = . ’s are QSVNR nowhere dense and QSVNR sets implies that are QSVNR dense and QSVNR sets in (,).Therefore QNR() = . Hence (,) is a QSVNR volterra space.

**Definition 3.17** *A QSVNRTS (,) is known as QSVNR p-space if countable intersection of QNROS in (,) in QSVNR open in (,).*

**Definition 3.18** *A QSVNRTS (,) is said to be QSVNR hyperconnected space if every QNROS is QSVNR dense set in (,) (i.e.,) QNR() = , for all .*

**Proposition 3.19** *If the QSVNRTS (,) be QSVNR p-space and QSVNR hyperconnected space then (,) is also a QSVNR volterra space.*

*Proof.* Let ’s ( to ) is QSVNR dense and QSVNR -sets in (,). Since (,) is QSVNR p-space, ’s is QSVNR sets, this implies that ’s is QNROS in (,).Then .Since (,) is a QSVNR hyperconnected space implies that QNR() = . Hence (,) is a QSVNR volterra space.

**Definition 3.20** *A QSVNRTS (,) is said to be QSVNR submaximal space if for each QSVNRS in (,) such that QNR() = , then .*

**Proposition 3.21** *If the QSVNRTS (,) be QSVNR submaximal and QSVNR hyperconnected space then (,) is a QSVNR volterra space.*

*Proof.* Let ’s ( to ) is QSVNR dense and QSVNR sets in (,). Since (,) is a QSVNR submaximal space QNR() = , implies that ’s for all( to ) this implies that . Since (,) is a QSVNR hyperconnected space, implies that QNR() = . Hence (,) is a QSVNR volterra space.

## 5 Conclusion

The concepts of quadripartitioned single valued neutrosophic refined volterra space as well as characterizations of these spaces is presented outcomes of functions that preserve quadripartitioned single valued neutrosophic refined volterra space in the context of images and preimages are obtained.

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