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On Fuzzy Semi Regular Volterra Spaces

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Abstract

In this paper, the notion of semi regular Volterra spaces in fuzzy setting is introduced. Some characterizations of fuzzy semi regular Volterra spaces are also studied in this paper.

Key words: Fuzzy semi dense set, fuzzy semi nowhere dense set, fuzzy semi G_δ-set, fuzzy semi F_σ-set, fuzzy semi regular G_δ-set, fuzzy semi regular F_σ-set, fuzzy semi first category set and fuzzy semi Volterra spaces.

AMS classification: 54A40, 03E72

1. Introduction

In 1970, J.Mack [4] introduced the concepts of regular G_δ-sets and regular F_σ-sets in classical topology. K.K.Azad [1] introduced fuzzy regular open and fuzzy regular closed sets in 1981. The concepts of regular G_δ-sets and regular F_σ-sets in fuzzy setting are introduced and studied in this paper. By using fuzzy regular G_δ-sets, the concepts of fuzzy regular Volterra and fuzzy regular weakly Volterra spaces are introduced in this paper. Several characterizations of fuzzy regular Volterra and fuzzy regular weakly Volterra spaces in terms of fuzzy regular F_σ-sets, fuzzy first category sets, fuzzy residual sets and fuzzy σ-nowhere dense sets are also established in this paper.

2. Preliminaries

In 1965, L.A.Zadeh [9] introduced the concept of fuzzy set λ on a base set X as a function from X into the unit interval $I = [0, 1]$. This function is also called a membership function. A membership function is a generalization of a characteristic function.

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Definition 2.1 [3] Let λ and μ be fuzzy sets in X. Then for all $x \in X$,

1. $\lambda = \mu \Leftrightarrow \lambda(x) = \mu(x)$,
2. $\lambda \leq \mu \Leftrightarrow \lambda(x) \leq \mu(x)$,
3. $\psi = \lambda \vee \mu \Leftrightarrow \psi(x) = max\{\lambda(x), \mu(x)\}$,
4. $\delta = \lambda \wedge \mu \Leftrightarrow \delta(x) = min\{\lambda(x), \mu(x)\}$,
5. $\eta = \lambda^c \Leftrightarrow \eta(x) = 1 - \lambda(x)$.

For a family $\{\lambda_i/i \in I\}$ of fuzzy sets in X, the union $\psi = \vee_i \lambda_i$ and intersection $\delta = \wedge_i \lambda_i$ are defined by $\psi(x) = sup_i\{\lambda_i(x), x \in X\}$, and $\delta(x) = inf_i\{\lambda_i(x), x \in X\}$.

The fuzzy set 0_X is defined as $0_X(x) = 0$, for all $x \in X$ and the fuzzy set 1_X defined as $1_X(x) = 1$, for all $x \in X$.

Definition 2.2 [3] A fuzzy topology is a family 'T'of fuzzy sets in X which satisfies the following conditions:

(1) $\Phi, X \in T$,
(2) If $A, B \in T$, then $A \cap B \in T$,
(3) If $A_i \in T$, for each $i \in I$, then $\cup_{i \in I} A_i \in T$.

T is called a fuzzy topology for X and the pair (X, T) is a fuzzy topological space or fts in short. Every member of T is called a T-open fuzzy set. A fuzzy set is T-closed if and only if its complement is T-open. When no confusion is likely to arise, we shall call a T-open (T-closed) fuzzy set simply an open (closed) fuzzy set.

Lemma 2.3 [1] Let (X, T) be any fuzzy topological space and λ be any fuzzy set in (X, T). We define the fuzzy semi-closure and the fuzzy semi-interior of λ as follows:

(i). $scl(\lambda) = \wedge\{\mu/\lambda \leq \mu, \mu$ is fuzzy semi-closed set of $X\}$
(ii). $sint(\lambda) = \vee\{\mu/\mu \leq \lambda, \mu$ is fuzzy semi-open set of $X\}$.

Lemma 2.4 [1] For a fuzzy set λ of a fuzzy space X,

(a) $1 - scl(\lambda) = sint(1 - \lambda)$ and
(b) $1 - sint(\lambda) = scl(1 - \lambda)$.

Lemma 2.5 [1] For a family $\mathcal{A} = \{\lambda_\alpha\}$ of fuzzy sets of a fuzzy space X. Then,

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$\vee\ cl\ \lambda_\alpha \leq cl(\vee\lambda_\alpha)$. In case $\mathcal{A}$ is a finite set, $\vee\ cl\ \lambda_\alpha = cl(\vee\lambda_\alpha)$. Also $\vee\ int\ \lambda_\alpha \leq int(\vee\lambda_\alpha)$.

Definition 2.6 [2] A fuzzy set λ in a fuzzy topological space X is called fuzzy semi-open if $\lambda \leq clint(\lambda)$ and fuzzy semi-closed if $intcl(\lambda) \leq \lambda$.

Definition 2.7 [8] A fuzzy set λ in a fuzzy topological space (X, T) is called a fuzzy semi G_δ-set in (X, T) if $\lambda = \wedge_{i=1}^{\infty}(\lambda_i)$, where (λ_i)'s are fuzzy semi open sets in (X, T).

Definition 2.8 [8] A fuzzy set λ in a fuzzy topological space (X, T) is called a fuzzy semi F_σ-set in (X, T) if $\lambda = \vee_{i=1}^{\infty}(\lambda_i)$, where (λ_i)'s are fuzzy semi closed sets in (X, T).

Definition 2.9 [7] A fuzzy set λ in a fuzzy topological space (X, T) is called fuzzy semi dense if there exists no fuzzy semi closed set μ in (X, T) such that $\lambda < \mu < 1$. That is, $scl(\lambda) = 1$.

Definition 2.10 [6] Let (X, T) be a fuzzy topological space. A fuzzy set λ in (X, T) is called a fuzzy semi nowhere dense set if there exists no non-zero fuzzy semi open set μ in (X, T) such that $\mu < scl(\lambda)$. That is, $sintscl(\lambda) = 0$.

Definition 2.11 [6] Let (X, T) be a fuzzy topological space. A fuzzy set λ in (X, T) is called fuzzy semi first category if $\lambda = \vee_{i=1}^{\infty}(\lambda_i)$, where (λ_i)'s are fuzzy semi nowhere dense sets in (X, T). Any other fuzzy set in (X, T) is said to be of fuzzy semi second category.

Definition 2.12 [6] If λ is a fuzzy semi first category set in a fuzzy topological space (X, T), then $1 - \lambda$ is called a fuzzy semi residual set in (X, T).

Definition 2.13 [5] A fuzzy set λ in a fuzzy topological space (X, T) is called a fuzzy semi σ-nowhere dense set if λ is fuzzy semi F_σ-set in X, T such that $sint(\lambda) = 0$.

Definition 2.14 [5] A fuzzy topological space (X, T) is called a fuzzy semi Volterra space if $scl\big(\wedge_{i=1}^{N}(\lambda_i)\big) = 1$, where (λ_i)'s are fuzzy semi dense and fuzzy semi G_δ-sets in (X, T).

Theorem 2.15 [1] In a fuzzy topological space (X, T),

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(a). The closure of a fuzzy open set is a fuzzy regular closed set
(b). The interior of a fuzzy closed set is a fuzzy regular open set.

3. Fuzzy semi regular G_δ-sets

Definition 3.1 A fuzzy set λ in a fuzzy topological space (X, T) is called a fuzzy semi regular G_δ-set if $\lambda = \wedge_{i=1}^{\infty}\big(sint(\lambda_i)\big)$, where $1 - \lambda_i \in T$.

Definition 3.2 A fuzzy set μ in a fuzzy topological space (X, T) is called a fuzzy semi regular F_σ-set if $\mu = \vee_{i=1}^{\infty}\big(scl(\mu_i)\big)$, where $\mu_i \in T$.

Proposition 3.3 If λ is a fuzzy semi regular G_δ-set in a fuzzy topological space (X, T) if and only if $1 - \lambda$ is a fuzzy semi regular F_σ-set in (X, T).

Proof: Let λ be a fuzzy semi regular G_δ-set in (X, T). Then $\lambda = \wedge_{i=1}^{\infty}\big(sint(\lambda_i)\big)$, where $1-\lambda_i \in T$. Now $1-\lambda = 1-\wedge_{i=1}^{\infty}\big(sint(\lambda_i)\big) = \vee_{i=1}^{\infty}\big(1-sint(\lambda_i)\big) = \vee_{i=1}^{\infty}\big(scl(1-\lambda_i)\big)$. Let $\mu_i = 1 - \lambda_i$. Then $\mu_i \in T$. Hence $1 - \lambda = \vee_{i=1}^{\infty}\big(scl(\mu_i)\big),\ \mu_i \in T$. Therefore $1 - \lambda$ is a fuzzy semi regular F_σ-set in (X, T).

Conversely, let λ be a fuzzy semi regular F_σ-set in (X, T). Then $\lambda = \vee_{i=1}^{\infty}\big(scl(\mu_i)\big)$, where $\mu_i \in T$. Now $1-\lambda = 1-\vee_{i=1}^{\infty}\big(scl(\mu_i)\big) = \wedge_{i=1}^{\infty}\big(1-scl(\mu_i)\big) = \wedge_{i=1}^{\infty}\big(sint(1-\mu_i)\big)$. Let $1 - \mu_i = \lambda_i$. Then implies that $\mu_i = 1 - \lambda_i$ and $1 - \lambda_i \in T$. Hence $1 - \lambda = \wedge_{i=1}^{\infty}\big(sint(\lambda_i)\big)$, where $1 - \lambda_i \in T$. Therefore $1 - \lambda$ is a fuzzy semi regular G_δ-set in (X, T).

Proposition 3.4 Let (X, T) be a fuzzy topological space.

(1). If λ is a fuzzy semi regular G_δ-set in (X, T), then $\lambda = \wedge_{i=1}^{\infty}(\delta_i)$, where (δ_i)'s are fuzzy semi regular open sets in (X, T).
(2). If λ is a fuzzy semi regular F_σ-set in (X, T), then $\lambda = \vee_{i=1}^{\infty}(\mu_i)$, where (μ_i)'s are fuzzy semi regular closed sets in (X, T).

Proof: (1). Let λ be a fuzzy semi regular G_δ-set in (X, T). Then $\lambda = \wedge_{i=1}^{\infty}\big(sint(\lambda_i)\big)$, where $1-\lambda_i \in T$. Now $1-\lambda_i \in T$ implies that λ_i is a fuzzy semi-closed set in (X, T). By theorem 2.15, $sint(\lambda_i)$ is a fuzzy semi regular open set in (X, T). Let $\delta_i = sint(\lambda_i)$. Then $\lambda = \wedge_{i=1}^{\infty}(\delta_i)$, where (δ_i)'s are fuzzy semi regular open sets in (X, T).

(2). Let λ be a fuzzy semi regular F_σ-set in (X, T). Then $\lambda = \vee_{i=1}^{\infty}\big(scl(\mu_i)\big)$, where $\mu_i \in T$. Now $\mu_i \in T$. By theorem 2.15, $scl(\mu_i)$ is a fuzzy semi regular closed set

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in (X,T). Let $\eta_i = scl(\mu_i)$. Then $\lambda = \vee_{i=1}^{\infty}(\eta_i)$, where (η_i)'s are fuzzy semi regular closed sets in (X,T).

Proposition 3.5 If λ is a fuzzy semi regular G_δ-set in a fuzzy topological space (X,T), then λ is a fuzzy semi G_δ-set in (X,T).

Proof: Let λ be a fuzzy semi regular G_δ-set in (X,T). Then by proposition 3.4, $\lambda = \wedge_{i=1}^{\infty}(\delta_i)$, where (δ_i)'s are fuzzy semi regular open sets in (X,T). Since every fuzzy semi regular open set is a fuzzy semi-open set in (X,T), (δ_i)'s are fuzzy semi-open sets in (X,T). Hence $\lambda = \wedge_{i=1}^{\infty}(\delta_i)$, where $\delta_i \in T$. Therefore λ is a fuzzy semi G_δ-set in (X,T).

Proposition 3.6 If λ is a fuzzy semi regular F_σ-set in a fuzzy topological space (X,T), then λ is a fuzzy semi F_σ-set in (X,T).

Proof: Let λ be a fuzzy semi regular F_σ-set in (X,T). Then by proposition 3.4, $\lambda = \vee_{i=1}^{\infty}(\eta_i)$, where (η_i)'s are fuzzy semi regular closed sets in (X,T). Since every fuzzy semi regular closed set is a fuzzy semi-closed set in (X,T), (η_i)'s are fuzzy semi-closed sets in (X,T). Hence $\lambda = \vee_{i=1}^{\infty}(\eta_i)$, where $1-\eta_i \in T$. Therefore λ is a fuzzy semi F_σ-set in (X,T).

4. Fuzzy semi regular Volterra spaces

Definition 4.1 A fuzzy topological space (X,T) is called a fuzzy semi regular Volterra space if $scl\big(\wedge_{i=1}^{N}(\lambda_i)\big) = 1$, where (λ_i)'s are fuzzy semi dense and fuzzy semi regular G_δ-sets in (X,T).

Proposition 4.2 If $sint\big(\vee_{i=1}^{N}(\mu_i)\big) = 0$ where (μ_i)'s are fuzzy semi regular F_σ-sets with $sint(\mu_i) = 0$ in a fuzzy topological space (X,T), then (X,T) is a fuzzy semi regular Volterra space.

Proof: Suppose that $sint\big(\vee_{i=1}^{N}(\mu_i)\big) = 0$, where (μ_i)'s are fuzzy semi regular F_σ-sets with $sint(\mu_i) = 0$. Now $1 - sint\big(\vee_{i=1}^{N}(\mu_i)\big) = 1$. Then, $scl\big(1 - \vee_{i=1}^{N}(\mu_i)\big) = 1$. This implies that $scl\big(\wedge_{i=1}^{N}(1-\mu_i)\big) = 1$. Since (μ_i)'s are fuzzy semi regular F_σ-sets in (X,T), by proposition 3.3, $(1-\mu_i)$'s are fuzzy semi regular G_δ-sets in (X,T). Also, $sint(\mu_i) = 0$ implies that $1 - sint(\mu_i) = 1$. Then, $scl(1-\mu_i) = 1$. Let $\lambda_i = 1-\mu_i$. Then (λ_i)'s are fuzzy semi dense and fuzzy semi regular G_δ-sets in (X,T). Hence,

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$scl\big(\wedge_{i=1}^{N} (\lambda_i)\big) = 1$, where (λ_i)'s are fuzzy semi dense and fuzzy semi regular G_δ-sets in (X, T). Therefore (X, T) is a fuzzy semi regular Volterra space.

Proposition 4.3 If a fuzzy topological space (X, T) is a fuzzy semi Volterra space, then (X, T) is a fuzzy semi regular Volterra space.

Proof: Let $\lambda = scl\big(\wedge_{i=1}^{N} (\lambda_i)\big)$.....(1), where (λ_i)'s are fuzzy semi dense and fuzzy semi regular G_δ-sets in (X, T). By proposition 3.5, the fuzzy semi regular G_δ-sets (λ_i)'s are fuzzy semi G_δ-sets in (X, T). Since (X, T) is a fuzzy semi Volterra space, $scl\big(\wedge_{i=1}^{N} (\lambda_i)\big) = 1$....(2), where (λ_i)'s are fuzzy semi dense and fuzzy semi G_δ-sets in (X, T). Hence, from (1) and (2), $\lambda = 1$. Therefore (X, T) is a fuzzy semi regular Volterra space.

Proposition 4.4 If a fuzzy topological space (X, T) is a fuzzy semi regular Volterra space, then $sint\big(\vee_{i=1}^{N} (\mu_i)\big) = 0$, where (μ_i)'s are fuzzy semi σ-nowhere dense sets in (X, T).

Proof: Let (X, T) be a fuzzy semi regular Volterra space. Then $scl\big(\wedge_{i=1}^{N} (\lambda_i)\big) = 1$, where (λ_i)'s are fuzzy semi dense and fuzzy semi regular G_δ-sets in (X, T). Now $1 - scl\big(\wedge_{i=1}^{N} (\lambda_i)\big) = 0$ implies that $sint\big(\vee_{i=1}^{N} (1 - \lambda_i)\big) = 0$. Since (λ_i)'s are fuzzy semi regular G_δ-sets, by proposition 3.3, $(1 - \lambda_i)$'s are fuzzy semi regular F_σ-sets in (X, T). By proposition 3.6, $(1 - \lambda_i)$'s are fuzzy semi F_σ-sets in (X, T). Also, $scl(\lambda_i) = 1$ implies that $1 - scl(\lambda_i) = 0$ and hence $sint(1 - \lambda_i) = 0$. Let $\mu_i = 1 - \lambda_i$. Then (μ_i)'s are fuzzy semi F_σ-sets with $sint(\mu_i) = 0$. Then, by the definition of fuzzy semi σ-nowhere dense sets, (μ_i)'s are fuzzy semi σ-nowhere dense sets in (X, T). Hence $sint\big(\vee_{i=1}^{N} (\mu_i)\big) = 0$, where (μ_i)'s are fuzzy semi σ-nowhere dense sets in (X, T).

Proposition 4.5 If $sint(\lambda) = 0$ for a fuzzy semi regular F_σ-set λ in a fuzzy topological space (X, T), then λ is a fuzzy semi first category set in (X, T).

Proof: Let λ be a fuzzy semi regular F_σ-set in (X, T). Then $\lambda = \vee_{i=1}^{\infty}\big(scl(\mu_i)\big)$, where $\mu_i \in T$. Now $sint(\lambda) = 0$ implies that $sint\big(\vee_{i=1}^{\infty} \big(scl(\mu_i)\big)\big) = 0$. But $\vee_{i=1}^{\infty}\big(sint\big(scl(\mu_i)\big)\big) \leq sint\big(\vee_{i=1}^{\infty} \big(scl(\mu_i)\big)\big) = 0$. Then, $\vee_{i=1}^{\infty}\big(sint\big(scl(\mu_i)\big)\big) = 0$. This implies that $sint\big(scl(\mu_i)\big) = 0$. Hence μ_i is a fuzzy semi nowhere dense set in (X, T). Also $sint\big(scl\big(scl(\mu_i)\big)\big) = sint\big(scl(\mu_i)\big) = 0$ implies that $scl(\mu_i)$ is a fuzzy semi nowhere dense set in (X, T). Hence $\lambda = \vee_{i=1}^{\infty}\big(scl(\mu_i)\big)$, where $\big(scl(\mu_i)\big)$'s are

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fuzzy semi nowhere dense sets in (X,T). Therefore λ is a fuzzy semi first category set in (X,T).

Proposition 4.6 If a fuzzy semi regular G_δ-set λ is a fuzzy semi dense set in a fuzzy topological space (X,T), then λ is a fuzzy semi residual set in (X,T).

Proof: Let λ be a fuzzy semi regular G_δ-set with $scl(\lambda)=1$. Then $1-\lambda$ is a fuzzy semi regular F_σ-set with $1-scl(\lambda)=0$. That is, $1-\lambda$ is a fuzzy semi regular F_σ-set with $sint(1-\lambda)=0$. Then by proposition 4.5, $1-\lambda$ is a fuzzy semi first category set in (X,T). Therefore λ is a fuzzy semi residual set in (X,T).

Proposition 4.7 If a fuzzy topological space (X,T) is a fuzzy semi regular Volterra space, then $scl\big(\wedge_{i=1}^{N}(\lambda_i)\big)=1$ where (λ_i)'s are fuzzy semi residual sets in (X,T).

Proof: Let (X,T) be a fuzzy semi regular Volterra space. Then $scl\big(\wedge_{i=1}^{N}(\lambda_i)\big)=1$, where (λ_i)'s are fuzzy semi dense and fuzzy semi regular G_δ-sets in (X,T). By proposition 4.6, (λ_i)'s are fuzzy semi residual sets in (X,T). Hence $scl\big(\wedge_{i=1}^{N}(\lambda_i)\big)=1$, where (λ_i)'s are fuzzy semi residual sets in (X,T).

Proposition 4.8 If a fuzzy topological space (X,T) is a fuzzy semi regular Volterra space, then $sint\big(\vee_{i=1}^{N}(\mu_i)\big)=0$, where (μ_i)'s are fuzzy semi first category sets in (X,T).

Proof: Let (X,T) be a fuzzy semi regular Volterra space. Then $scl\big(\wedge_{i=1}^{N}(\lambda_i)\big)=1$, where (λ_i)'s are fuzzy semi dense and fuzzy semi regular G_δ-sets in (X,T). Now $1-scl\big(\wedge_{i=1}^{N}(\lambda_i)\big)=0$ implies that $sint\big(1-\wedge_{i=1}^{N}(\lambda_i)\big)=0$. Then, $sint\big(\vee_{i=1}^{N}(1-\lambda_i)\big)=0$. Now (λ_i)'s are fuzzy semi regular G_δ-sets in (X,T) implies that $(1-\lambda_i)$'s are fuzzy semi regular F_σ-sets in (X,T). Also $scl(\lambda_i)=1$ implies that $1-scl(\lambda_i)=0$. Then $sint(1-\lambda_i)=0$. Hence, $(1-\lambda_i)$'s are fuzzy semi regular F_σ-sets with $sint(1-\lambda_i)=0$. Therefore by proposition 4.5, $(1-\lambda_i)$'s are fuzzy semi first category sets in (X,T). Let $\mu_i=1-\lambda_i$. Hence if (X,T) is a fuzzy semi regular Volterra space, then $sint\big(\vee_{i=1}^{N}(\mu_i)\big)=0$, where (μ_i)'s are fuzzy semi first category sets in (X,T).

5. Conclusion

In this paper, the concept of fuzzy semi regular Volterra spaces have introduced and also some of their characteristics have investigated and studied.

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DOI : http://doi.org/10.26524/cm52

References

[1] Azad KK, On fuzzy semicontinuity, fuzzy almost continuity and fuzzy weakly continuity, J. Math. Anal. Appl.,82, 1981, 14-32.

[2] Bin Shahna AS, On fuzzy strong semicontinuity and fuzzy precontinuity, Fuzzy Sets and Systems, 44, 1991, 303-308.

[3] Chang CL, Fuzzy topological spaces, J.Math. Anal. Appl., 24, 1968, 182-190.

[4] Mack J, Countable paracompactness and weak normality properties, Trans. Amer. Math. Soc., 148, 1970, 265-272.

[5] Saravanan P, Soundara Rajan S, Chandiran V, On fuzzy semi Volterra spaces, JETIR, 6(6), 2019, 374-380.

[6] Thangaraj G, Anjalmose S, Fuzzy semi-Baire spaces, International Journal of Innovative Science, Engineering & Technology, 1(4), 2014, 335-341.

[7] Thangaraj G, Balasubramanian G, On somewhat fuzzy semicontinuous functions, Kybernetica, 37(2), 2001, 165-170.

[8] Thangaraj G, Palani R, On fuzzy Baire spaces and fuzzy semi closed sets, Ann. Fuzzy Math. Inform., 10(6), 2015, 905-912.

[9] Zadeh LA, Fuzzy sets, Information and Control, 8, 1965, 338-353.

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