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Neutrosophic Crisp Tri-Topological Spaces

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Abstract – In this paper we will introduce neutrosophic crisp Tri-topological spaces, and we will introduce four new types of open and closed sets in neutrosophic crisp Tri-topological spaces. Then, the closure and interior neutrosophic crisp set will be defined via this new concept of open and closed sets. Finally, we will introduce the basic properties of these types of open and closed sets and the properties of new concept of closure and the interior.

Keywords – Neutrosophic crisp Tri-topological spaces, neutrosophic crisp Tri-open set, neutrosophic crisp Tri-closed set, neutrosophic crisp S-open sets and neutrosophic crisp S-closed.

1 Introduction

Smarandache introduces neutrosophy. He has laid the foundation of new mathematical theories generalizing their fuzzy counterparts, [8,9,10]. Many introduced the introduction of the Neutrosophic set concepts in many of their works [11,12,13,14,15,16, 5, 6,7]. In [12, 17] provides a natural foundation for treating mathematically the neutrosophic phenomena which exist pervasively in our real world and for building new branches of neutrosophic mathematics. Smarandache introduces the concept of neutrosophic sete as generalization of the concept of fuzzy sets [1] and intuitionistic fuzzy sets [2,3]. Lupianez has developed and modified many of papers about neutrosophic in his papers in [21, 22,23,24,25]. Hamido introduces neutrosophic crisp Bi-topological space [1].

In this paper we will introduce the concept of neutrosophic crisp Tri-topological as generalization of the concept of neutrosophic crisp Bi-topological [1]. Then, we will introduce new types of open and closed sets as neutrosophic crisp Tri-open sets, neutrosophic crisp Tri-closed sets, neutrosophic crisp TriS-open sets and neutrosophic crisp TriS-closed sets. We investigated the properties of these new four types of neutrosophic crisp sets.

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2 Preliminaries

In this section, we recollect some basic preliminaries, and in particular, the work of Smarandache in [8,9,10], and Salama in [11, 12,13,14, 15,16, 5, 4,7]. Smarandache in his work introduced the neutrosophic components T, I, F which represent the membership, indeterminacy, and non-membership values respectively, where $\rfloor^{-}0,1^{+}\lfloor$ is a non-standard unit interval. Hanafy and Salama et al. [7,15] considered some possible definitions for basic concepts of the neutrosophic crisp set and its operations.

Definition 2.1. [19] Let X be a non-empty fixed set. A neutrosophic crisp set (NCS) A is an object having the form $A = \{A_1, A_2, A_3\}$, where A_1, A_2, and A_3 are subsets of X satisfying $A_1 \cap A_2 = \phi$, $A_1 \cap A_3 = \phi$, and $A_2 \cap A_1 = \phi$.

Definition 2.2. [19] Types of $NCSs$ ϕ_N and X_N [20] in X as follows:

1- ϕ_N may be defined in many ways as a NCS, as follows

1. $\phi_N = (\phi, \phi, X)$ or
2. $\varphi_N = (\phi, X, X)$ or
3. $\phi_N = (\phi, X, \phi)$ or
4. $\phi_N = (\phi, \phi, \phi)$

2- X_N may be defined in many ways as a NCS, as follows

1. $X_N = (X, \phi, \phi)$ or
2. $X_N = (X, X, \phi)$ or
3. $X_N = (X, X, X)$.

Definition 2.3. [19] Let X is a non-empty set, and the NCSs A and B in the form $A = \{A_1, A_2, A_3\}$, $B = \{B_1, B_2, B_3\}$. Then we may consider two possible definitions for subsets $A \subseteq B$, may defined in two ways:

1. $A \subseteq B \Leftrightarrow A_1 \subseteq B_1, A_2 \subseteq B_2$, and $A_3 \supseteq B_3$ or
2. $A \subseteq B \Leftrightarrow A_1 \subseteq B_1, A_2 \supseteq B_2$, and $A_3 \supseteq B_3$

Definition 2.4. [19] Let X is a non-empty set, and the NCSs A and B in the form $A = \{A_1, A_2, A_3\}$, $B = \{B_1, B_2, B_3\}$. Then:

1. $A \cap B$ may be defined in two ways as a NCS, as follows:

i) $A \cap B = (A_1 \cap B_1, A_2 \cap B_2, A_3 \cup B_3)$
ii) $A \cap B = (A_1 \cap B_1, A_2 \cup B_2, A_3 \cup B_3)$

2. $A \cup B$ may be defined in two ways as a NCS, as follows:

i) $A \cup B = (A_1 \cup B_1, A_2 \cap B_2, A_3 \cap B_3)$
ii) $A \cup B = (A_1 \cup B_1, A_2 \cup B_2, A_3 \cap B_3)$

Definition 2.5. [19] A neutrosophic crisp topology (NCT) on a non-empty set X is a family Γ of neutrosophic crisp subsets in X satisfying the following axioms.

1. $\phi_N, X_N \in \Gamma$.
2. $A_1 \cap A_2 \in \Gamma$, for any A_1 and $A_2 \in \Gamma$.
3. $\cup A_j \in \Gamma$, $\forall \{A_j : j \in J\} \subseteq \Gamma$.

The pair (X,Γ) is said to be a neutrosophic crisp topological space (NCTS) in X. Moreover, the elements in Γ are said to be neutrosophic crisp open sets (NCOS), A neutrosophic crisp set F is closed (NCCS) if and only if its complement F^c is an open neutrosophic crisp set.

Definition 2.6. [19] Let X is a non-empty set, and the NCSs A in the form $A=\{A_1,A_2,A_3\}$. Then A^c may be defined in three ways as a NCS, as follows:

i) $A^c = < A_1^c, A_2^c, A_3^c >$ or
ii) $A^c = < A_3, A_2, A_1 >$ or
iii) $A^c = < A_3, A_2^c, A_1 >$.

Definition 2.7. *[1]* Let Γ_1, Γ_2 be two neutrosophic crisp topology (NCT) on a nonempty set X then (X,Γ_1,Γ_2) neutrosophic crisp Bi-topological space (Bi-NCTS for short).In this case:

- The elements in $\Gamma_1 \cup \Gamma_2$ are said to be neutrosophic crisp Bi-open sets (Bi-NCOS for short). A neutrosophic crisp set F is closed (Bi-NCCS for short) if and only if its complement F^c is an neutrosophic crisp Bi-open set.

- the family of all neutrosophic crisp Bi-open sets is denoted by (Bi-NCOS(X)).

- the family of all neutrosophic crisp Bi-closed sets is denoted by (Bi-NCCS(X)).

3 Neutrosophic Crisp Tri-Topological Spaces

In this section, We will introduce Neutrosophic Tri-topological crisp Spaces .

Moreover we will introduce new types of open and closed sets in Neutrosophic Tri-topological crisp Spaces.

Definition 3.1. Let Γ_1,Γ_2 and Γ_3 be three neutrosophic crisp topology (NCT) on a nonempty set X then $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ neutrosophic crisp Tri-topological space (Tri-NCTS for short).

Example 3.2. Let X={1,2,3,4}, $\Gamma_1=\{\Phi_N, X_N, D, C\}$, $\Gamma_2=\{\Phi_N, X_N, A\}$, $\Gamma_3=\{\Phi_N, X_N, B\}$, $A=<\{1\},\{2,4\},\{3\}>=C$, $B=<\{1\},\{2\},\{3,4\}>$, $D=<\{1\},\{2\},\{3\}>$. Then (X,Γ_1), (X,Γ_2) and (X,Γ_3) are neutrosophic crisp spaces therefore $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ is neutrosophic crisp Tri-topological space (Tri-NCTS).

Definition 3.3. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS) then:

-The elements in $\Gamma_1\cup\Gamma_2\cup\Gamma_3$ are said to be neutrosophic crisp Tri-open sets (Tri-NCOS for short). A neutrosophic crisp set F is closed (Tri-NCCS for short) if and only if its complement F^c is an neutrosophic crisp Tri-open set.

- the family of all neutrosophic crisp Tri-open sets is denoted by (Tri-NCOS(X)).

- the family of all neutrosophic crisp Tri-closed sets is denoted by (Tri-NCCS(X)).

Example 3.4. In Example 2 the neutrosophic crisp Tri-open sets (Tri-NCOS) are: Tri-NCOS(X) = $\Gamma_1\cup\Gamma_2\cup\Gamma_3$={A,B,C,D} the neutrosophic crisp Tri-closed sets (Tri-NCCS) are : Tri-NCCS(X) = $\Gamma_1\cup\Gamma_2\cup\Gamma_3=\{\phi_N, X_N, A_1, B_1, C_1, D_1\}$, where:

$A_1=<\{2,3,4\},\{1,3\},\{1,2,4\}>=C_1$, $B_1=<\{2,3,4\},\{1,3,4\},\{1,2\}>$,
$D_1=<\{2,3,4\},\{1,3,4\},\{1,2,4\}>$.

Remark 3.5.
1) Every neutrosophic crisp open sets in (X,Γ_1) or (X,Γ_2) or (X,Γ_3) is neutrosophic crisp Tri-open set.

2) Every neutrosophic crisp closed sets in (X,Γ_1) or (X,Γ_2) or (X,Γ_3) is neutrosophic crisp Tri-closed set.

Remark 3.6. Every neutrosophic crisp Tri-topological space $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ induces three neutrosophic crisp topological spaces as (X,Γ_1), (X,Γ_2) and (X,Γ_3).

Remark 3.7. If (X,Γ) neutrosophic crisp topological space then (X,Γ,Γ,Γ) neutrosophic crisp Tri-topological space.

Theorem 3.8. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS) then: The union of two neutrosophic crisp Tri-open (Tri-closed) sets is not neutrosophic crisp Tri-open (Tri-closed) set as the following example:

Example 3.9. X={1,2,3,4}, $\Gamma_1=\{\Phi_N, X_N, A\}$, $\Gamma_2=\{\Phi_N, X_N, D\}$, $\Gamma_3=\{\Phi_N, X_N, C\}$. It is clear that (X,Γ_1), (X,Γ_2) and (X,Γ_3) are neutrosophic crisp topological spaces therefore is $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ neutrosophic crisp Tri-topological space A, D are two neutrosophic crisp Tri-open sets but $A\cup D=<\{1,3\},\{2,4\},\varnothing>$ is not neutrosophic crisp Tri-open set. $A^c=<\{1,2,4\},\{1,3\},\{2,3,4\}>, D^c=<\{2,3,4\},\{1,3,4\},\{1,2,4\}>$ are two neutrosophic crisp Tri-closed sets but $A^c\cup D^c=<X,\{1,3\},\{2,4\}>$ is not neutrosophic crisp Tri-closed set.

Theorem 3.10. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS) then: The intersection of two neutrosophic crisp Tri-open (Tri-closed) sets is neutrosophic crisp Tri-open (Tri-closed) set as the following example:

Example 3.11. In example 3.9 A, D are two neutrosophic crisp Tri-open sets but $A \cap D =< \varnothing, \{2\}, \{1,3\} >$ is not neutrosophic crisp Tri-open set.

$$A^c =< \{1,2,4\}, \{1,3\}, \{2,3,4\} >, D^c =< \{2,3,4\}, \{1,3,4\}, \{1,2,4\} >$$

are two neutrosophic crisp Tri-closed sets but $A^c \cap D^c =< \{2,4\}, \{1,3\}, X >$ is not neutrosophic crisp Tri-closed set.

4 The Closure and the Interior via Neutrosophic Crisp Tri-Open Sets (Tri-NCOS) and Neutrosophic Crisp Tri-closed (Tri-NCCS)

In this section we use this new concept of open and closed sets in the definition of closure and interior Neutrosophic crisp set, where we defined the closure and interior Neutrosophic crisp set based on these new varieties of open and closed Neutrosophic crisp sets.Also we introduced the basic properties of closure and the interior.

Definition 4.1. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS), and A is neutrosophic crisp set then: The union of any neutrosophic crisp Tri-open sets ,contain in A is called neutrosophic crisp Tri-interior of A ($NC^{Tri}Int(A)$ for short). $NC^{Tri}Int(A) = \cup\{B : B \subseteq A$; B is neutrosophic crisp tri-open set$\}$.

Theorem 4.2. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$be neutrosophic crisp Tri-topological space (Tri-NCTS), A is neutrosophic crisp set then:

1. $NC^{Tri}Int(A) \subseteq A$.
2. $NC^{Tri}Int(A)$ is not neutrosophic crisp Tri-open set .

Proof:
1. Follow from the defintion of $NC^{Tri}Int(A)$ as a union of any *neutrosophic crisp Tri-open set*s ,contains in A.

2. Follow from Theorem 8 in section 3.

Theorem 4.3. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS), A, B are neutrosophic crisp sets then:

$$A \subset B \Rightarrow NC^{Tri}Int(A) \subset NC^{Tri}Int(B).$$

Proof: Obvious.

Definition 4.4. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS), A is neutrosophic crisp set then: The intersection of any neutrosophic crisp Tri-open sets ,contained A is called neutrosophic crisp Tri-closure of A (NC^{Tri}-Cl(A) for short). $NC^{Tri}\text{-}Cl(A) = \cap\{B : B \supseteq A$; B is an neutrosophic Tri-closed set$\}$.

Theorem 4.5. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS), A is neutrosophic crisp set then:

1. $A \subseteq NC^{Tri}$-Cl(A) .
2. NC^{Tri}-Cl(A) is not neutrosophic crisp Tri-closed set.

Proof:
1. Follow from the defintion of NC^{Tri}-Cl(A) as a intersection of any neutrosophic crisp Tri-closed set,contained in A**.**

2. Follow from Theorem 3.10.

5 The Neutrosophic crisp TriS-open Sets (TriS-NCOS) and Neutrosophic Crisp TriS-closed sets (TriS-NCOS)

We introduced new concept of open and closed sets in neutrosophic crisp Tri-topological space in this section, as neutrosophic crisp TriS-open sets (TriS-NCOS) and neutrosophic crisp TriS-closed sets (S-NCCS). Also we introduced the basic properties of this new concept of open and closed sets in Tri-NCTS , and their relationship with neutrosophic crisp Tri-open sets and neutrosophic crisp Tri-closed sets.

Definition 5.1. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$be neutrosophic crisp Tri-topological space (Tri-NCTS) then: The neutrosophic crisp open set only in one of the three neutrosophic crisp topological space (X,Γ_1), (X,Γ_2) and (X,Γ_3) are called neutrosophic crisp TriS-open set (TriS-NCOS for short).

- The complement of neutrosophic crisp S-open set is called neutrosophic crisp TriS-closed set (Tri-NCCS for short).

- the family of all neutrosophic crisp triS-open sets is denoted by (TriS-NCOS(X)).

- the family of all neutrosophic crisp TriS-closed sets is denoted by (TriS-NCCS(X)).

Example 5.2. In example 3.2: B, D are two neutrosophic crisp S-open sets.

Theorem 5.3. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS) then:

1. Every neutrosophic crisp TriS-open sets (TriS-NCOS) is neutrosophic crisp Tri-open set (Tri-NCOS).

2. Every neutrosophic crisp TriS-closed sets (TriS-NCCS) is neutrosophic crisp Tri-closed set (Tri-NCCS).

Proof:
1. Let A neutrosophic crisp TriS-open set therefore A neutrosophic crisp open set in one of the three neutrosophic crisp topological spaces (X,Γ_1), (X,Γ_2) and (X,Γ_3) therefore A neutrosophic crisp Tri-open set.

2. Let A neutrosophic crisp TriS-closed set therefore A neutrosophic crisp closed set in one of the three neutrosophic crisp topological spaces (X,Γ_1), (X,Γ_2) and (X,Γ_3) therefore A neutrosophic crisp Tri- closed set.

Remark 5.4. The converse of Theorem 3 is not true , as the following example.

Example 5.5. In any neutrosophic crisp Tri-topological space, Φ_N, X_N are two neutrosophic crisp Tri-open sets, but Φ_N , X_N are not neutrosophic crisp TriS-open sets .

Also Φ_N, X_N are two neutrosophic crisp Tri-closed sets, but Φ_N, X_N are not neutrosophic crisp TriS-closed sets.

Theorem 5.6. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS) then: The union of two neutrosophic crisp TriS-open (TriS-closed) sets is neutrosophic crisp TriS-open (TriS-closed) set as the following example.

Example 5.7. In example 3.9. It is clear that (X,Γ_1), (X,Γ_2) and (X,Γ_3) are neutrosophic crisp topological spaces therefore $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ is neutrosophic crisp Tri-topological space. A,D are two neutrosophic crisp TriS-open sets but $A \cup D =< \{1,3\},\{2,4\},\varnothing >$ is not neutrosophic crisp TriS-open set.

$$A^c =< \{1,2,4\},\{1,3\},\{2,3,4\} >, D^c =< \{2,3,4\},\{1,3,4\},\{1,2,4\} >$$

are two neutrosophic crisp TriS-closed sets but $A^c \cup D^c =< X ,\{1,3\},\{2,4\} >$ is not neutrosophic crisp TriS-closed set.

Theorem 5.8. Let $(X,\Gamma_1,\Gamma_2,\Gamma_3)$ be neutrosophic crisp Tri-topological space (Tri-NCTS) then: The intersection of two neutrosophic crisp TriS-open (TriS-closed) sets is neutrosophic crisp TriS-open (TriS-closed) set as the following example.

Example 5.9. In example 3.9. A, D are two neutrosophic crisp TriS-open sets but $A \cap D =< \varnothing,\{2\},\{1,3\} >$ is not neutrosophic crisp TriS-open set.

$$A^c =< \{1,2,4\},\{1,3\},\{2,3,4\} >, D^c =< \{2,3,4\},\{1,3,4\},\{1,2,4\} >$$

are two neutrosophic crisp TriS-closed sets but $A^c \cap D^c =< \{2,4\},\{1,3\},X >$ is not neutrosophic crisp TriS-closed set.

Conclusions

In this paper we have introduced neutrosophic crisp *Tri*-Topological space. Then we have introduced neutrosophic crisp *Tri*-open, neutrosophic crisp *Tri*-closed, neutrosophic crisp TriS-open, neutrosophic crisp TriS-open set's. Also we studied some of their basic properties and their relationship with each other. Finally, these new concepts are going to pave the way for new types of open and closed sets as neutrosophic Crisp Tri-α-open sets, neutrosophic crisp Tri-β-open sets, neutrosophic crisp Tri-pre-open sets, neutrosophic crisp Tri-semi-open sets.

References

[1] R. K. Al-Hamido, Neutrosophic Crisp Bi-Topological Space, Communicated.
[2] K. Atanassov, intuitionistic fuzzy sets. in V.Sgurev, ed., Vii ITKRS Session, Sofia (June 1983 central Sci. and Techn. Library, Bulg. Academy of Sciences (1984).
[3] K. Atanassov, intuitionistic fuzzy sets, fuzzy sets and systems 20, (1986) , 87-96.
[4] S. A. Alblowi, A. A. Salama and M. Eisa, New concepts of neutrosophic sets. International Journal of Mathematics and Computer Applications Research (IJMCAR) 4, (2014), 59-66.
[5] S. A. Alblowi, A. A. Salama, and Mohmed Eisa. New concepts of neutrosophic sets. International Journal of Mathematics and Computer Applications Research (IJMCAR) 3 , (2013), 95-102.
[6] I. Hanafy, A. A. Salama and K. Mahfouz, Correlation of neutrosophic data. International Refereed Journal of Engineering and Science (IRJES) 1, (2012), 39-43.
[7] I. M. Hanafy, A. A. Salama and K. M. Mahfouz, Neutrosophic crisp events and its probaTrility. International Journal of Mathematics and Computer Applications Research (IJMCAR) 3, (2013), 171-178.
[8] F. Smarandache, Neutrosophy and Neutrosophic Logic, First International Conference on Neutrosophy, Neutrosophic Logic, Set, ProbaTrility, and Statistics, University of New Mexico, NM 87301, USA(2002).
[9] F. Smarandache, A Unifying Field in Logics: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic ProbaTrility. American Research Press, Rehoboth, NM, (1999).
[10] F. Smarandache, An introduction to the Neutrosophy probaTrility applid in Quntum Physics. International Conference on introducation Neutrosoph Physics, Neutrosophic Logic, Set, ProbaTrility, and Statistics, University of New Mexico, Gallup, NM 87301, USA2-4 December (2011).
[11] F. Smarandache, An introduction to the Neutrosophy probaTrility applid in Quntum Physics. International Conference on introducation Neutrosoph Physics, Neutrosophic Logic, Set, ProbaTrility, and Statistics, University of New Mexico, Gallup, NM 87301, USA2-4 December (2011).
[12] A. A. Salama and S. A. Alblowi, Neutrosophic set and neutrosophic topological space. ISORJ, Mathematics 3, (2012), 31-35.
[13] A. A. Salama and S. A. Alblowi, Generalized Neutrosophic Set and Generalized Neutrousophic Topological Spaces. Journal computer Sci. Engineering 2, (2012), 29-32.
[14] A. A. Salama and S. A. Alblowi, Intuitionistic Fuzzy Ideals Topological Spaces. Advances in Fuzzy Mathematics 7, (2012), 51- 60.
[15] A. A. Salama, and H. Elagamy, Neutrosophic Filters. International Journal of Computer Science Engineering and Information Technology Reseearch (IJCSEITR) 3, (2013), 307-312.
[16] A. Salama, Neutrosophic Crisp Points and Neutrosophic Crisp Ideals. Neutrosophic Sets and Systems 1, (2013), 50-54.
[17] A. Salama and F. Smarandache, Filters via Neutrosophic Crisp Sets. Neutrosophic Sets and Systems 1, (2013), 34-38.
[18] A. A. Salama and S. A. Alblowi, Intuitionistic Fuzzy Ideals Topological Spaces. Advances in Fuzzy Mathematics 7, (2012), 51- 60.
[19] D. Sarker, Fuzzy ideal theory, Fuzzy local function and generated fuzzy topology. Fuzzy Sets and Systems 87, (1997), 117-123.

[20] A. Salama, F. Smarandache and V. Kroumov, Neutrosophic crisp Sets and Neutrosophic crisp Topological Spaces, Neutrosophic Sets and Systems 2, (2014), 25-30.
[21] A. Salama, Basic Structure of Some Classes of Neutrosophic Crisp Nearly Open Sets and Possible Application to GIS Topology. Neutrosophic Sets and Systems 7, 2015, 18-22.
[22] F. G. Lupianez, On neutrosophic topology, Kybernetes 37 (2008), 797-800.
[23] F. G. Lupianez, Interval neutrosophic sets and topology, Kybernetes 38 (2009), 621-624.
[23] F. G. Lupianez, On various neutrosophic topologies, Kybernetics 38 (2009), 1009-1013.
[24] F. G. Lupianez, On neutrosophic sets topology, In F. Smarandache, & S. Pramanik (Eds.), New trends in neutrosophic theory and applications. Pons Editions, Brussel, 2016, 305-313.
[25] L. A. Zadeh, Fuzzy Sets, Inform and Control 8, (1965), 338-353.