A Short Introduction To The Symbolic Turiyam Vector Spaces and Complex Numbers

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Abstract:

This paper is dedicated to define for the first time the concept of Symbolic Turiyam vector space as a generalization of the corresponding neutrosophic one by using the algebra of symbolic Turiyam set. Also, we illustrate many examples to show and clarify the validity of this work.

Key words: Turiyam matrix, Turiyam Set, Turiyam Space, Turiyam Context.

Introduction

Recently, Turiyam set [91-93] is produced for dealing the data beyond three-way fuzzy space [1-10] for knowledge processing tasks. In this process the symbolic turiyam ring structures [78] is also introduced as a new algebraic generalization of the corresponding neutrosophic one [1-10]. In this process, a problem is arises for defining the Turiyam space for precise representation of

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Turiyam set. Some of the researchers tried to represent the three-way fuzzy space data sets using Neutrosophic set [11-20] and its algebraic structures [21-30] with an extensive properties [31-40]. The refined neutrosophic set provided a way to deal with many-valued data sets in three-way fuzzy space [41-50] and its topology [51-60] for multi-decision tasks [61-75]. The problem arises when the data set contains independent values for acceptation, rejection and uncertain parts as well as Turiyam [76-78]. It is observed in neutrosophic set which contains independent acceptation, rejection and uncertain values exists in intuitionistic fuzzy set [79-84]. It become more crucial in case every opinion considered as independent like acceptation, rejection, uncertain and None of the above condition [85-88]. One of the suitable examples is COVID 19 data which contain fourth dimensions uncertainty for the analysis. The people who got recovered can be considered as true regions(t), people who died due to COVID 19 can be considered as false regions(f), people who are still active can be considered as indeterminacy(i), people who got vaccinated can be considered as Turiya or Liberated state(l). The refusal degree means people who still did not come under these regions can be represented as 1-(t +i +f +l) [89-93]. To deal with these types of data set current paper introduce Turiyam space in this paper.

In the literature, mant authors have contributed to algebraic structures in neutrosophic systems such as neutrosophic rings, spaces, modules , and matrices [10-25, 31-45, 50-66].

In this work, we extend the previous efforts to the case of the symbolic Turiyam set, where we define the symbolic Turiyam vector space, the AH-turiyam subspace, AHS-Turiyam subspace, and AH-Turiyam linear transformation, which are considered as generalizations of the AH-substructures defined in [6-8, 27].

This work may be very useful in future studied to generalize classical algebraic structures and to study the rerlationships between Turiyam sets and classical sets.

Main Discussion

Definition

Let F be a field and V be a vector space over F.

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Let $F_u = \{a_0 + a_1T + a_2F + a_3I + a_4Y;\ a_i \in F\}$be the corresponding symbolicTuriyam field (STF). We define the symbolic Turiyam vector space (STVS) as follows:

V_u =$\{x_0 + x_1T + x_2F + x_3I + x_4Y;\ x_i \in V\}$.

Example

Let $V = R^2$ be the 2-dimensional Eucledian vector space over the real field R. The corresponding (STVS) over $F_u$is:

V_u =$\{(x_0, y_0) + (x_1, y_1)T + (x_2, y_2)F + (x_3, y_3)I + (x_4, y_4)Y\}$.

$V_u = \{(x_0 + x_1T + x_2F + x_3I + x_4Y, y_0 + y_1T + y_2F + y_3I + y_4Y);\ x_i, y_i \in R\}$.

Theorem

Let $V_u$be the symbolic Turiyam vector space (STVS) over the (STF) F_u, hence V_u is a module over F_u in the ordinary algebraic meaning.

Definition:

Let V_u =$\{x_0 + x_1T + x_2F + x_3I + x_4Y;\ x_i \in V\}$ be a Symbolic Turiyam vector space. Let V_i; i=0..4 be subspaces of V. We define the corresponding Turiyam AH-subpace as the following:

$M_u = V_0 + V_1T + V_2F + V_3I + V_4Y$=$\{x_0 + x_1T + x_2F + x_3I + x_4Y;\ x_i \in V_i\}$.

If $V_0 = V_1 = V_2 = V_3 = V_4$, then M_u is called Symbolic Turiyam AHS-subspace.

Example

Let $V = R^2$be a vector space over R.

$V_1 = \{(a, 0), a \in R\}$, $V_2 = \{(0, b), b \in R\}$ are two subspace of V.

$M_u = \{V_1 + V_2T + V_1F + V_3I + V_2Y\} = \{(a_1, 0) + (0, b_1)T + (a_2, 0)F + (0, b_2)I + (0, b_3)Y\}$ is an AH-subspace.

$N_u = \{V_1 + V_1T + V_1F + V_1I + V_1Y\} = \{(a_1, 0) + (a_2, 0)T + (a_3, 0)F + (a_4, 0)I + (a_5, 0)Y\}$ is an AH-subspace.

Definition

Let $L_i: V \to W$ be linear transformation; $i = 0, \dots, 4$. We define the corresponding AH-linear Turiyam transformation as follows:

$L: V_u \to W_u; L(x_0 + x_1T + x_2F + x_3I + x_4Y) = L_0(x_0) + L_1(x_1)T + L_2(x_2)F + L_3(x_3)I + L_4(x_4)Y$.

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If $L_0 = L_1 = L_2 = L_3 = L_4$, then we get AHS-Turiyam linear transformation.

Example

Consider the following classical linear transformations:

$L_1: R^2 \to R^2;\ L_1(x, y) = (y, x).$

$L_2: R^2 \to R^2;\ L_2(x, y) = (x, x + y).$

Now, we are able to build AH-Turiyam linear transformation as follows:

$L: R_u^2 \to R_u^2; L\big((x_0, y_0) + (x_1, y_1)T + (x_2, y_2)F + (x_3, y_3)I + (x_4, y_4)Y\big) = L_1(x_0, y_0) +$

$L_2(x_1, y_1)T + L_1(x_2, y_2)F + L_2(x_3, y_3)I + L_2(x_4, y_4)Y = (y_0, x_0) + (x_1, x_1 + y_1)T +$

$(y_2, x_2)F + (x_3, x_3 + y_3)I + (x_4, x_4 + y_4)Y.$

Also, we can build an AHS-Turiyam linear transformation as follows:

$T: R_u^2 \to R_u^2; T\big((x_0, y_0) + (x_1, y_1)T + (x_2, y_2)F + (x_3, y_3)I + (x_4, y_4)Y\big) = L_1(x_0, y_0) +$

$L_1(x_1, y_1)T + L_1(x_2, y_2)F + L_1(x_3, y_3)I + L_1(x_4, y_4)Y,$

$= (y_0, x_0) + (y_1, x_1)T + (y_2, x_2)F + (y_3, x_3)I + (y_4, x_4)Y.$

Definition

We define the Turiyam complex number as follows:

$Z = x_0 + x_1T + x_2F + x_3I + x_4Y;\ x_i \in C.$

The cingucate of Z is defined:

$\bar{Z} = \overline{x_0} + \overline{x_1}T + \overline{x_2}F + \overline{x_3}I + \overline{x_4}Y$

The set of all Turiyam complex numbers is defined by C_T.

Remark

C_T contains the neutrosophic field of complex numbers $C(I)$.

Example

Take $Z_1 = (1 + i) + (2 - i)T + iF + I - 3iY, Z_2 = -i + 4iT - 5iF + (3 - i)I + (1 - i)Y.$

We have:

$\overline{Z_1} = (1 - i) + (2 + i)T - iF + I + 3iY, \overline{Z_2} = i - 4iT + 5iF + (3 + i)I + (1 + i)Y.$

Remark

$\overline{(Z_1 + Z_2)} = \overline{Z_1} + \overline{Z_2}, \overline{(Z_1 - Z_2)} = \overline{Z_1} - \overline{Z_2}, \overline{(Z_1.Z_2)} = \overline{Z_1}.\overline{Z_2}.$

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Remark

Not all Turiyam complex numbers have inverses, for example $Z = iT$ is not invertible.

Conclusion

In this paper, we have defined the Symbolic Turiyam vector spaces and Turiyam Complex numbers. Also, we have illustrated many examples to clarify the validity of our definitions.

This work is considered as a part of a largest project to define and study the Turiyam algebraic structures.

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