An Introduction To The Symbolic Turiyam R-Modules and Turiyam Modulo Integers

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Abstract:

Recently, Turiyam set is introduced for dealing the fourth dimensional data sets. These types of data sets exists when an expert unable to categorize them in Euclidean, Non-Euclidean, Hybrid or NeutroGeometry. To deal with these types of data set Turiyam matrix and its algebra is required. Hence the current paper introduce the concept of Symbolic Turiyam R-module as a generalization of the corresponding neutrosophic one by using the algebra of symbolic Turiyam set. The paper also presents concept pf finite Turiyam modulo integer and illustrate many examples to show and clarify the validity of this work.

Key words: Fourth Dimension; Symbolic Turiyam matrix, Turiyam module, Hermit-Turiyam matrix, Turiyam Set.

Introduction

Current decade much attention has been paid towards algebraic structures for characterization of data in acceptation, rejection and uncertain regions [1-10], its defined ring [11-20] at given space. The neutrosophic modules [31-40] and its properties given a way to deal with multi-attribute data sets via refined neutrosophic set [41-

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50]. The extensive properties of neutrosophic matrices [51-60] and its topology [61-75] established a way for its various applications. The problem arises when the data set contains uncertainty beyond the acceptation, rejection and uncertain part which can be categorized based on time or distance [76-84]. Some time we can say as librated state which refusal degree can be represented as 4-(Acceptation+Rejection+Uncertain+Turiya) in case of dependent dimension. One of the suitable examples people vote to a particular party (t), does not vote to a particular party (f), absentation (i), none of the above (l) . This dimension is called as Turiyam. The refusal degree means people who does wants to vote can be found via 1-(t+i+f+l) [85-91]. Another example is any types of data set can be represented as Euclidean space, Non-Euclidean Space or Anti-geometry, and Hybrid Space i.e. Euclidean+Non-Euclidean, Euclidean+AntiGeometry, Non-Euclidean+AntiGeometry can be called as NeutroGeometry. The problem arises when a data cannot be represented via these three space. This type of data is called as Turiyam which follows Anisotropy pattern. To deal with these types of data set turiyam set [91-93] is introduced recently for approximation of uncertainty[94]. However its basic algebra is required to establish for further applications [95-96]. To achieve this goal, the current paper focused on introducing the Turiyam Modules in this paper.

The symbolic turiyam set was defined in [78] as a new algebraic generalization of the corresponding neutrosophic one [91-93]. Recently, symbolic Turiyam rings [78], Turiyam complex number [95] and its matrix is studied [96]. These studies motivated n this work, we extend the previous efforts to the case of the symbolic Turiyam set, where we define the symbolic Turiyam R-modules, the AH-turiyam submodule, AHS-Turiyam submodule, and AH-Turiyam module homomorphism, which are considered as generalizations of the AH-substructures defined in [6-8, 27, 76-78, 91-96].

Main Discussion

Definition

Let R be a ring and V be a module over R.

Let $R_u = \{a_0 + a_1T + a_2F + a_3I + a_4Y;\ a_i \in F\}$be the corresponding symbolicTuriyam ring (STR). We define the symbolic Turiyam module (STM) as follows:

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

Example

Let $V = Z^2$ be a module over the ring of integers Z. The corresponding (STM) over $R_u$is:

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

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

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Theorem

Let $V_u$be the symbolic Turiyam module (STM) over the (STR) R_u, hence V_u is a module over R_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 module. Let V_i; i=0..4 be submodules of V. We define the corresponding Turiyam AH-submodule 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-submodule.

Example

Let $V = R^2$be a module over R.

$V_1 = \{(a, 0), a \in R\}, V_2 = \{(0, b), b \in R\}$ are two submodules 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-submodule.

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

Definition

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

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

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

Example

Consider the following classical module hommorphisms:

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

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

Now, we are able to build AH-Turiyam homomorphism 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 module homomorphism 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 modulo integer as follows:

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

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The set of all Turiyam modulo integers is defined by T_{Z_n}.

Remark

T_{Z_n} contains the neutrosophic ring of modulo integers $Z_n(I)$.

Example

Consider the set of integers modulo 5, $Z_5 = \{0,1,2,3,4\}$

Take $Z_1 = 1 + 4T + 2F + I + 3Y$, $Z_2 = 4 + 4T + F + I + 2Y$.

We have:

$Z_1 + Z_2 = 3T + 3F + 2I$.

Definition

We define the symbolic Turiyam modulo integers matrix as follows:

$A = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix}$; a_{ij} is a symbolic Turiyam modulo integer.

Example

Consider the following 2×2 Turiyam modulo 4 matrices:

$$A = \begin{pmatrix} 1 + 2T + F & 3F + Y \\ 2I + Y & 3Y \end{pmatrix}$$

$$B = \begin{pmatrix} 3 + T + I & 2 + I \\ 1 + Y & 2F \end{pmatrix}$$

$$A + B = \begin{pmatrix} 3T + F + 2I + Y & 2 + 3F + I + Y \\ 1 + 2I + 2Y & 2F + 3Y \end{pmatrix}$$

Example

Take:

$$A = \begin{pmatrix} 1 + F & 2 + T + I \\ -1 - Y & Y \end{pmatrix}$$

$$B = \begin{pmatrix} I + F & I - F \\ F & T + Y \end{pmatrix}$$

$$A \times B = \begin{pmatrix} 5F + I & 3T - 2F + 3Y \\ -F - 2I & F - 2I + 3Y \end{pmatrix} = \begin{pmatrix} F + I & 3T + 2F + 3Y \\ 3F + 2I & F + 2I + 3Y \end{pmatrix}$$

Where $-1 \equiv 3(mod4), -2 \equiv 2(mod4)$.

Conclusion

This paper defines the Symbolic Turiyam module and its finite modulo integer for matrix representation. Each of the definitions are illustrated with an example for better understanding and its applications in various fields.

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

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