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# An Application Of Complete Intuitionistic Fuzzy Hypergraph In CT Scans

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**Abstract**

Diseases can be treated appositely by the doctors only after exact diagnosis for which CT scans lend helping hand. Repeated subjection of a patient to CT scans cause side effects at the same time limitation to the exposure makes the process of diagnosis difficult. A safe and scientific way of developing the process of using CT scan in the follow-up of cancer using fuzzy hypergraph and stability of hypergraph was developed by Hanan Abdualaziz and Mujahid. This paper introduces the concept of Intuitionistic fuzzy hypergraph (IFHG) , completeness and stability of intuitionistic fuzzy hypergraph and also applies in developing the new approach of developing the process of CT scans exposure. This research work is an extension of Hanan Abdualaziz and Mujahid and it presents the viability of Intuitionistic fuzzy sets in real life application.

**Keywords**

Fuzzy Hypergraph, Intuitionistic Fuzzy Hypergraph, Complete Fuzzy Hypergraph.

## 1. Introduction

Hyper graph is a generalization of graphs in which an edge can connect more than two vertices. This distinct nature of hyper graph theory was initiated by Berge in $19^{th}$ century which has made the researchers to apply in decision making process, partitioning, clustering, image segmenting and so on. Recent theoretical developments have revealed that the concept of fuzzy sets introduced by Zadeh in 1965 provides more flexibility to handle the uncertainty present in nature. Likewise, in 1986,Atanassov introduced the concepts of Intuitionistic fuzzy sets as a generalization of fuzzy sets. The fuzzified notion

 

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of hyper graph was introduced by Kauffman. The applicability of fuzzy graphs has widened by the generalization of fuzzy hyper graphs which have been verified from the earlier works to be more useful mathematical modeling tools. Later on,Moderson and Nair presented a valuable contribution on fuzzy graphs as well as fuzzy hyper graphs in [6] .Lee Kwang and K.M.Lee studied the fuzzy hyper graphs using fuzzy partition.Intuitionistic fuzzy hyper graphs were defined by Parvathi and Thilagavathi in 2013[7 ]. Akram and Dudek gave a new definition to Intuitionistic fuzzy hyper graphs and they also discussed the application of Intuitionistic fuzzy hyper graphs.

Researchers such as [5] have explicated the extensive role of IFHG in medical diagnosis. The medical imaging techniques provide great help to the doctors to investigate the condition of the patient affected by vulnerable disease like cancer. Among many different imaging modalities, Computed Tomography (CT) is widely used for diagnosis of hepatic disease as it can provide relatively high resolution images with accurate anatomical information. The need for accurate and efficient information is essential for doctors to save patient ‘s life by administering the precise treatment. In this regard patient is exposed to CT scans often to obtain the sequential growth and spread of the disease. Furthermore , exposing the patient to CT scans will also give side effects. Preventing the patient from side effects, usage of taking CT scan could be minimized and at the same time the degree of inference to be obtained for further treatment must not be intruded. This problem was studied by Hanan and Mujahid recently, in which the authors have presented a complete fuzzy hyper graph model along with the notion of stability to represent the image obtained by CT scans. The stability measures are used for diagnosing and follow up of the patient.

In the problem considered for study, the representation was made in terms of fuzzy values, but as intuitionistic fuzzy sets are highly viable than fuzzy sets, a new approach of intuitionistic fuzzy representation is developed. The complete fuzzy hyper graph with stability is extended to complete intuitionistic fuzzy hyper graph model with stability measures. Fuzzy representation just portrays the projection of the beam to the pixel, but in IFS illustration the spread of the beam to the pixel is depicted. This is the main pro of the newly proposed model. In addition the intuitionistic fuzzy relation which is denoted as relation between beams as the hyper edge and pixels as vertices can provide more information about the spread of the beam.This will duly assist the doctors in making inferences.

The paper is structured as follows ,In section 2,we review several basic concepts of fuzzy hyper graphs,Intuitionistic fuzzy relation,similarity measures of intuitionistic fuzzy sets.In section 3,we present the definition of Intuitionistic fuzzy hypergraph using intuitionistic fuzzy relation ,complete intuitionistic fuzzy hyper graphs.In section 4,we discuss the similarity measures and stability of complete

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Intuitionistic fuzzy hypergraph.In section 5,we render the application of Intuitionistic fuzzy hyper graphs,Finally we give conclusion in section 6.

## 2. Preliminaries

A binary relation $R$ from set $X$ to $Y$ is a subset of the Cartesian product $X \times Y$ .the relation can be represented using a directed graph for each ordered pair $(X, Y)$ in the relation $R$ ,there will be a directed edge from vertex $x$ to vertex $y$ .a relation is an equivalence relation if it is reflexive, symmetric and transitive.

Degrees of association can be represented by membership grades in a fuzzy relation in the same way as degrees of set. Formally a fuzzy relation is a fuzzy set defined as the Cartesian product of crisp set $X_1, X_2............X_n$ where tuple $(x_1, x_2..........x_n)$ may have varying degrees of membership with in the relation. The membership grade is usually represented by a real member in the closed interval $[0,1]$ and indicates the strength of the relation present between the elements of the tuple.

The relation between two sets $X$ & $Y$ can be represented by membership matrix which is also known as incidence matrix.

### 2.1. Definition

An intuitionistic fuzzy relation is an intuitionistic fuzzy subset of $X \times Y$ that is an expression $R$ given by $R = \{\langle x, y\rangle, \mu_R(x, y), \gamma_R(x, y), x \in X, y \in Y\}$ where $\mu_R : X \times Y \to [0,1], \gamma_R : X \times Y \to [0,1]$ satisfy the condition $0 \le \mu_R(x, y) + \gamma_R(x, y) \le 1$ for any $(x, y) \in X \times Y$

### 2.2. Definition

The triple $H = (E, V, M)$ is called hypergraph, if

1. $V$ is a set of points.

2. $E$ is a set of hyper edges.

3. $M \subset E \times V$ is a relation called the incidence.

### 2.3. Definition

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Let $H=(E,V,M)$ be a hypergraph, $V$ a finite set, let $R$ be a finite family of non-trivial fuzzy relation of $\{\mu/\mu:E\times V\rightarrow[0,1]\}$ such that $V=\bigcup_j \mu_j^*$ ,where $\mu_j^*=\{v\in V/\mu_j(e_j,v)>0\}$ then the triple

$FH=(E,V,\mu)$ is called a fuzzy hypergraph as $V$ . $\mu:E\times V\rightarrow[0,1]$ is a fuzzy relation called fuzzy incidence. $E$ is the (crisp) set of hyperedge of $H$ and $V$ is the (crisp) vertex $x$ set of $H$.

**2.4. Definition**

Let $H=(E,V,M)$ be a fuzzy hypergraph, we define the following fuzzy sets $i,\varepsilon:E\rightarrow[0,1]$ such that for each $e\in E$, $i(e)$ is called the initial value of $e$ and $\varepsilon(e)$ is called the final value of $e$.

$\chi_j:V\rightarrow[0,1]$ such that, for each $v_j\in V$ is called the local value of $v_j$.

**2.5. Definition**

Let $FH=(E,V,\mu)$ be a fuzzy hypergraph, where $V=\{v_1,v_2..........v_n\}, E=\{e_1,e_2..........e_m\}$.let $i(e),\varepsilon(e)$ be the initial value and final value of $e$ respectively.

Define the map $\bar{\mu}:E\rightarrow I\times I^V\times I$ such that $\bar{\mu}(e)=\left\{i(e),\frac{v_1}{\mu(e,v_1)},\frac{v_2}{\mu(e,v_2)}..........\frac{v_n}{\mu(e,v_n)},\varepsilon(e)\right\}$

Then $\overline{FH}=(E,V,\bar{\mu})$ is called a complete fuzzy hypergraph.

**3. Complete Intuitionistic Fuzzy Hypergraph**

In this section we give a new definition for intuitionistic fuzzy hypergraph in terms of intuitionistic fuzzy relation which is different from the definitions of Parvathi et al, and Akram. The definition we have given here is useful in real life applications.

**3.1. Definition**

Let $H=(E,V,M)$ be a hyper graph,$V$ a finite set. Let $\Re$ be a finite family of non –trivial Intuitionistic Fuzzy Relation of $\{(\mu,\gamma)/(\mu,\gamma):E\times V\rightarrow[0,1]\times[0,1]$ such that

$V=\cup_j(\mu_j^*,\gamma_j^*)$. Where $(\mu_j^*,\gamma_j^*)=\{v\in V/\mu_j(e_j,v)>0\,\&\,\gamma_j(e_j,v)>0\}$

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Then $IFH = (E, V, (\mu, \gamma))$ is called a Intuitionistic Fuzzy Hyper graph on V.

$(\mu, \gamma): E \times V \to [0,1] \times [0,1]$ is a intuitionistic Fuzzy relation called intuitionistic fuzzy incidence. E is the set of hyper edge of H and V is the vertex set of H.

### 3.2. Example

Let $V = \{v_1, v_2, v_3, v_4\}$ cells of the solar panel and $E = \{e_1, e_2, e_3\}$ be a set such that $e_1, e_2, e_3$ is the light waves which face the cells of the panel during day time.

$(\mu, \gamma): E \times V \to [0,1] \times [0,1]$ such that $\left(\mu(v_i, e_j), \gamma(v_i, e_j)\right)$are the ratios of the light waves that the cells of the panel receives and does not receive.

$$IFH = (E, V, \mu, \gamma) = \begin{array}{c c} & \begin{array}{cccc} v_1 & v_2 & v_3 & v_4 \end{array} \\ \begin{array}{c} e_1 \\ e_2 \\ e_3 \end{array} & \begin{bmatrix} (0.5,0.2) & (0.3,0.3) & (0.4,0.2) & (0.4,0.2) \\ (0.3,0.1) & (0.2,0.2) & (0.4,0.3) & (0.5,0.1) \\ (0.6,0.2) & (0.4,0.2) & (0.3,0.2) & (0.3,0.3) \end{bmatrix} \end{array}$$

### 3.3. Definition

Let$IFH = \left(E, V, (\mu, \gamma)\right)$be a intuitionistic fuzzy hyper graph .We define the following intuitionistic fuzzy set,$i, \varepsilon : E \to [0,1] \times [0,1]$ such that for each $e \in E, i(e) = (\mu_i(e), \gamma_i(e))$ is called initial membership and non-membership value of e, and $\varepsilon(e) = (\varepsilon_i(e), \varepsilon_i(e))$ is called final membership and non-membership value of e.

$\chi_j: V \to [0,1] \times [0,1]$ Such that ,for each $v_j \in V$ is called the local value of $v_j$.

### 3.4. Definition

Let $IFH = \left(E, V, (\mu_1, \gamma_1)\right) \& IFH = \left(E, V, (\mu_2, \gamma_2)\right)$ be two intuitionistic fuzzy hypergraph then

(i)$[(\mu_1, \gamma_1) \cup (\mu_2, \gamma_2)](e, v) = \left(max\left(\mu_1(e, v), \mu_2(e, v)\right), min\left(\gamma_1(e, v), \gamma_2(e, v)\right)\right)$

$$for e \epsilon E_1 \cap E_2$$

Also $[(\mu_1, \gamma_1) \cup (\mu_2, \gamma_2)](e, v) = (\mu_1, \gamma_1)(e, v) for e \epsilon E_1 \setminus E_2$

And $[(\mu_1, \gamma_1) \cup (\mu_2, \gamma_2)](e, v) = (\mu_2, \gamma_2)(e, v) for e \epsilon E_2 \setminus E_1$.

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(ii) )$[(\mu_1,\gamma_1)\cap(\mu_2,\gamma_2)](e,v) = \left(min(\mu_1(e,v),\mu_2(e,v)), max(\gamma_1(e,v),\gamma_2(e,v))\right)$

$$for all e \epsilon E_1 \cap E_2, Zero Otherwise.$$

**3.5.Definition**

Let $IFH=(E,V,(\mu_1,\gamma_1))$ & $IFH=(E,V,(\mu_2,\gamma_2))$ be two Intuitionistic fuzzy hyper graphs then we say that $IFH=(E,V,(\mu_1,\gamma_1))$ is a Intuitionistic fuzzy sub hypergraph of & $IFH=(E,V,(\mu_2,\gamma_2))$

If (i) $E_1 \subseteq E_2$ (ii)$(\mu_1,\gamma_1)(e,v) \le (\mu_2,\gamma_2)(e,v) for all e \epsilon E_1, E_2 and v \in V$.

**3.6. Definition**

Let $IFH = (E,V,1,0)$ is said to be absolute intuitionistic fuzzy hyper graph, Where $(1,0)(e,v) = 1\, for all e \in E, v \in V$and the Intuitionistic fuzzy hyper graph $IFH = (E,V,0,1)$ is said to be null intuitionistic fuzzy hypergraph, where $(0,1)(e,v) = 0\, for all e \in E, v \in V$.

**3.7. Definition**

Let $IFH=(E,V,(\mu,\gamma))$ be intuitionistic fuzzy hypergraph, where $V=\{v_1,v_2....v_n\}, E=\{e_1,e_2....e_m\}$ .let $i(e),\xi(e)$be the initial and final value of $e$ respectively.

Define the map $\bar{\mu}: E \to I \times I^v \times I$ such that $\bar{\mu}(e)=\left\{i(e),\frac{v_1}{(\mu,\gamma)(e,v_1)},\frac{v_2}{(\mu,\gamma)(e,v_2)}.......\frac{v_n}{(\mu,\gamma)(e,v_n)},\xi(e)\right\}$ then the in $\overline{IFH}=(E,V,\mu,\gamma)$ is called a complete intuitionistic hypergraph.

**3.8. Example**

Let $IFH=(E,V,(\mu,\gamma))$ be as in previous example, $i(e)$ be the initial value of the light waves and $\xi(e)$ be the final value of the light waves.

Suppose that $i(e_1)=(\mu_i(e_1),\gamma_i(e_1))=(0.9,0.1)$

$i(e_2)=(\mu_i(e_2),\gamma_i(e_2))=(0.8,0.2)$

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$i(e_3) = (\mu_i(e_3), \gamma_i(e_3)) = (1.0,,0)$

$\xi(e_1) = (\mu_\xi(e_1), \gamma_\xi(e_1)) = (0.4,0.2)$

$\xi(e_2) = (\mu_\xi(e_2), \gamma_\xi(e_2)) = (0.4,0.3)$

$\xi(e_3) = (\mu_\xi(e_3), \gamma_\xi(e_3)) = (0.6,0.2)$

Then $(\bar{\mu}, \bar{\gamma})(e_1) = \left\{(0.9,0.1), \frac{v_1}{(0.5,0.2)}, \frac{v_2}{(0.7,0.3)}, \frac{v_3}{(0.4,0.2)}, \frac{v_4}{(0.4,0.2)}, (0.5,0.2)\right\}$

$(\bar{\mu}, \bar{\gamma})(e_2) = \left\{(0.8,0.2), \frac{v_1}{(0.3,0.1)}, \frac{v_2}{(0.2,0.2)}, \frac{v_3}{(0.4,0.3)}, \frac{v_4}{(0.5,0.1)}, (0.4,0.3)\right\}$

$(\bar{\mu}, \bar{\gamma})(e_3) = \left\{(0.1,0), \frac{v_1}{(0.6,0.2)}, \frac{v_2}{(0.4,0.2)}, \frac{v_3}{(0.3,0.2)}, \frac{v_4}{(0.3,0.3)}, (0.6,0.2)\right\}$ and $\overline{IFH} = (E, V, \mu, \gamma)$ is a complete intuitionistic fuzzy hypergraph.

**4. Stability of Two Complete Intuitionistic Fuzzy Hypergraph**

Decision making is the process of finding the feasible solution to the problem after comparing the alternatives. In reality the situations of making the right choice are bounded to uncertainty and impreciseness, to overcome such hurdles the concept of fuzzy sets is used. The comprehensive extension of fuzzy sets is the intuitionistic fuzzy sets (IFS) in which the representations of data are highly viable. The degree of similarity between two or more objects is essential for comparative analysis of IFS representation and it is determined by using similarity measures. Similarity measures between any two intuitionistic fuzzy sets have been studied by many authors which is used in different areas such as approximate reasons,rule matching,control and database query and so on. There are various forms of similarity measures one such is distance measure. Distance measure between two IFS was proposed by Burillo and Bustines. Liu gave the axiomatic definition of distance and similarity measures of fuzzy sets and discussed the relationship between them. In this section we define stability of two complete Intuitionistic fuzzy hypergraph as an extension of Hanan Abdualaziz and Mujahid's definition of stability in complete fuzzy hypergraph.

**4.1.Definition**

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Let $H=(E,V,M)$ be a hypergraph, $V$ a finite set, let $R$ be a finite family of non- trivial intuitionistic fuzzy relations $(\mu,\gamma):E\times V\to[0,1]\times[0,1]$ then a similarity measure is an upper bound function $S:R\times R\to[0,1]$ and dissimilarity measure is a lower bound function $d:R\times R\to[0,1]$.

In literature many authors define different similarity measures for $IF$ sets.Among those we use Hung and Yang's similarity measures in this paper.

For any two $IFs$ $\overline{A}$ & $\overline{B}$ in $X$ ,the similarity measures between then,

$$S(\overline{A},\overline{B})=1-\frac{\sum_{i=1}^{n}\left(\left|\mu_{\overline{A}}(x_i)-\mu_{\overline{B}}(x_i)\right|+\left|\gamma_{\overline{A}}(x_i)-\gamma_{\overline{B}}(x_i)\right|\right)}{\sum_{i=1}^{n}\left(\left|\mu_{\overline{A}}(x_i)+\mu_{\overline{B}}(x_i)\right|+\left|\gamma_{\overline{A}}(x_i)+\gamma_{\overline{B}}(x_i)\right|\right)}$$ we can look at similarity and dissimilarity measures as a relations between $IFs$. $\sim_{\varepsilon},\sim_{\delta}:R\times R\to[0,1]$ respectively as follows,

$A\sim_{\varepsilon} B$ iff $S(A,B)\geq\varepsilon$

$A\sim_{\delta} v$ iff $d(A,B)\leq\delta$ where $\varepsilon,\delta\to[0,1], A,B\in R$

**4.2. Definition**

Let $IFH_1=(E,V,A), IFH_2=(E,V,B)$ be two intuitionistic fuzzy hypergraph, where $V=\{v_1,v_2....v_n\}, E=\{e_1,e_2....e_m\}$.we say that $(E,V)$ is significantly dissimilar under $(\mu_A,\gamma_A)$&$(\mu_B,\gamma_B)$ with respect to $\varepsilon(\delta)$ if

$S(A,B)\geq\varepsilon$ , $d(A,B)\leq\delta$ where $A=(\mu_1,\gamma_1)$ and $B=(\mu_2,\gamma_2)$ and $\varepsilon,\delta\leftarrow[0,1]$.

$$S_i(A,B)=1-\frac{\sum_{j=1}^{n}\left(\left|\mu_A(e_i,v_j)-\mu_B(e_i,v_j)\right|+\left|\gamma_A(e_i,v_j)-\gamma_B(e_i,v_j)\right|\right)}{\sum_{j=1}^{n}\left(\left|\mu_A(e_i,v_j)+\mu_B(e_i,v_j)\right|+\left|\gamma_A(e_i,v_j)+\gamma_B(e_i,v_j)\right|\right)} \quad \text{for} \quad i=1,2...m$$

$$S(A,B)=\min_{i} S_i(A,B)$$

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Similarly $d_i(A,B)=1-\dfrac{\sum_{j=1}^{n}\left(\left|\mu_A(e_i,v_j)-\mu_B(e_i,v_j)\right|+\left|\gamma_A(e_i,v_j)-\gamma_B(e_i,v_j)\right|\right)}{\sum_{j=1}^{n}\left(\left|\mu_A(e_i,v_j)+\mu_B(e_i,v_j)\right|+\left|\gamma_A(e_i,v_j)+\gamma_B(e_i,v_j)\right|\right)}$ for $i=1,2\ldots m$

$$d(A,B)=\max_i d_i(A,B)$$

Here $d=1-S$ (ie) $d$ is the complement of $S$.

**4.3. Example**

Let $IFH_1=(E,V,A), IFH_2=(E,V,B), IFH_3=(E,V,C)$,be Intuitionistic Fuzzy Hypergraph, where $V=\{v_1,v_2\}, E=\{e_1,e_2\}$ such that

$$A=\begin{array}{c} \\ e_1 \\ e_2 \end{array}\begin{array}{c} \begin{array}{cc} v_1 & v_2 \end{array} \\ \begin{pmatrix} (0.3,0.2) & (0.2,0.1) \\ (0.5,0.2) & (0.4,0.3) \end{pmatrix} \end{array}, B=\begin{array}{c} \\ e_1 \\ e_2 \end{array}\begin{array}{c} \begin{array}{cc} v_1 & v_2 \end{array} \\ \begin{pmatrix} (0.4,0.2) & (0.6,0.3) \\ (0.8,0.2) & (0.3,0) \end{pmatrix} \end{array}, C=\begin{array}{c} \\ e_1 \\ e_2 \end{array}\begin{array}{c} \begin{array}{cc} v_1 & v_2 \end{array} \\ \begin{pmatrix} (0.3,0.2) & (0.8,0.1) \\ (0.6,0.1) & (0.7,0.2) \end{pmatrix} \end{array}$$

Let $\varepsilon=0.80$ then

$$S_1(A,B)=1-\frac{(0.1+0)+(0.4+0.2)}{(0.7+0.4)+(0.8+0.4)}$$

$$=1-\frac{0.7}{3.1}=1-0.23=0.77$$

$$S_2(A,B)=1-\frac{(0.3+0)+(0.1+0.3)}{(1.3+0.4)+(0.7+0.3)}$$

$$=1-\frac{0.7}{2.7}=1-0.26=0.74$$

$$S(A,B)=\min_i(0.77,0.74)=0.74<0.8$$

And $S_1(B,C)=1-\dfrac{(0.1+0)+(0.2+0.2)}{(0.7+0.4)+(1.4+0.4)}$

 

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$$=1-\frac{0.5}{2.9}=1-0.17=0.83$$

$$S_2(B,C)=1-\frac{(0.2+0.1)+(0.4+0.2)}{(1.4+0.3)+(1.0+0.2)}$$

$$=1-\frac{0.9}{2.9}=1-0.31=0.69$$

$$S(B,C)=\min_i(0.83,0.69)=0.74<0.8$$

Then $A$ is not significantly similar to $B$ and also $B$ is not significantly similar to $C$ with respect to $\varepsilon$ .

$$S_1(A,C)=1-\frac{(0+0)+(0.6+0)}{(0.6+0.4)+(1.0+0.2)}$$

$$=1-\frac{0.6}{2.2}=1-0.27=0.73$$

$$S_2(A,C)=1-\frac{(0.1+0.1)+(0.3+0.1)}{(1.1+0.2)+(1.1+0.5)}$$

$$=1-\frac{0.6}{3}=1-0.2=0.8$$

$$S(A,C)=\min_i(0.73,0.8)=0.73<0.8$$

Then $A$ is not significantly similar to $C$ and $B$ with respect to $\varepsilon$ .

**4.4. Definition**

Let $\overline{IFH}_1=(E,V,\overline{A}),\overline{IFH}_2=(E,V,\overline{B})$ be two complete Intuitionistic Fuzzy Hypergraph, where $V=\{v_1,v_2....v_n\},E=\{e_1,e_2....e_m\}$.the pair $(E,V)$ is said to be significantly stable under $\overline{A}$ & $\overline{B}$ with respect to $\varepsilon_j\delta_j$ if $i_A(e_i)=i_B(e_i)$ for all $i=1,2,......m$ & $S(A,B)\geq\delta$ then

$S(\varepsilon(e_A),\varepsilon(e_B))\geq E$ where

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$$S(\varepsilon(e_A),\varepsilon(e_B)) = 1 - \frac{\sum_{j=1}^{m}\left(\left|\in_{\mu_A}(e_i) - \in_{\mu_B}(e_i)\right| + \left|\in_{\gamma_A}(e_i) - \in_{\gamma_B}(e_i)\right|\right)}{\sum_{j=1}^{m}\left(\left|\in_{\mu_A}(e_i) + \in_{\mu_B}(e_i)\right| + \left|\in_{\gamma_A}(e_i) + \in_{\gamma_B}(e_i)\right|\right)}$$

The stability is denoted as $stab(\overline{A},\overline{B})$ and its value $stab(\overline{A},\overline{B}) = S(\varepsilon(e_A),\varepsilon(e_B))$

**4.5.Example**

Let $\overline{IFH}_1 = (E,V,\overline{A}), \overline{IFH}_2 = (E,V,\overline{B}), \overline{IFH}_3 = (E,V,\overline{C})$ be complete intuitionistic fuzzy hypergraph, where $V = \{v_1, v_2, v_3\}, E = \{e_1, e_2, e_3\}$ such that

$$\overline{A} = \begin{array}{c} \\ e_1 \\ e_2 \\ e_3 \end{array}\begin{array}{c} \begin{array}{cccc} v_1 & v_2 & v_3 & v_4 \end{array} \\ \begin{pmatrix} (0.9,0.1) & (0.5,0.2) & (0.3,0.3) & (0.4,0.2) \\ (0.4,0.2) & (0.5,0.1) & (0.8,0.2) & (0.3,0.1) \\ (0.6,0.2) & (0.3,0.2) & (0.6,0.2) & (0.3,0.3) \end{pmatrix} \end{array}$$

$$\overline{B} = \begin{array}{c} \\ e_1 \\ e_2 \\ e_3 \end{array}\begin{array}{c} \begin{array}{cccc} v_1 & v_2 & v_3 & v_4 \end{array} \\ \begin{pmatrix} (0.6,0.2) & (0.9,0) & (0.5,0.3) & (0.2,0.1) \\ (0.4,0.5) & (0.2,0.3) & (0.7,0.1) & (0.8,0.2) \\ (0.6,0.1) & (0.5,0.4) & (0.3,0.3) & (0.2,0.2) \end{pmatrix} \end{array}$$

$$\overline{C} = \begin{array}{c} \\ e_1 \\ e_2 \\ e_3 \end{array}\begin{array}{c} \begin{array}{cccc} v_1 & v_2 & v_3 & v_4 \end{array} \\ \begin{pmatrix} (0.4,0.2) & (0.5,0.3) & (0.2,0.1) & (0.4,0.4) \\ (0.8,0.1) & (0.8,0) & (0.3,0.2) & (0.2,0.1) \\ (0.6,0.3) & (0.7,0.2) & (0.5,0.4) & (0.3,0.3) \end{pmatrix} \end{array}$$

By routine computation (E,V) is unstable under $\overline{A}$ & $\overline{B}$ with respect to $\varepsilon,\delta$.

**5. An Application of Complete Intuitionistic Fuzzy Hypergraphs in CT Scans**

Modern medicine relies heavily on imaging methods, X-rays were used in the beginning of the 20th century. There are two forms of imaging methods used (i) Internal (ii) external. X-rays and

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ultrasound methods work by having an external source of radiation that comes from a source outside the body.The radiation is then detected after it has passed through the body and an image is constructed from the way that this source is absorbed.

In modern life cycle, due to environmental degradation and food habits, people are prone to get different type of cancers. However the medical examination for the patient stars with CT Scans, MRI and etc. Each time large number of beams pass through the human body to give the image of the affected area will also cause many side effects.The purpose of this paper is to help the doctors to give enough information about the affected area is the body after doing CT scan for the first time.

In this case we assume that each beam to be a Intuitionistic Fuzzy Hyper edge and each pixel to be vertex of a intuitionistic fuzzy hypergraph $H = (E, V, M)$ where $E$ is the beams and $V$ is the pixels and $M$ denotes its matrix.

**5.1. Example**

Suppose that there is a patient with stomach cancer,when he did the CT scan for the first time his information as follows,

Let $V = \{v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8\}$ be the set of pixels, and $E = \{e_1, e_2, e_3, e_4, e_5, e_6, e_7, e_8\}$ be the set of beams passing through the stomach, such that $e_1, e_2, e_3$ are passing horizontally $e_4, e_5, e_6, e_{10}$ are passing diagonally and $e_7, e_8, e_9$ are passing vertically.

$\overline{A} = (\mu_1, \gamma_1) : E \times V \to [0,1] \times [0,1]$ such that $\mu_1(v_i, e_j)$ is the area of the pixel $v_i$ that is passing the beam $e_i$ and $\gamma_1(v_i, e_j)$ is the area of the pixel $v_i$ that is not properly facing the beam $e_j$ .Let $(\varepsilon_{\mu_1}(e), \varepsilon_{\gamma_1}(e))$ be proper density and improper density of the beam e after it leaves the body.Then

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$$
\overline{A} = \begin{array}{cc}
 & \begin{array}{ccccccccc} v_1 & v_2 & v_3 & v_4 & v_5 & v_6 & v_7 & v_8 & \varepsilon_A(e) \end{array} \\
\begin{array}{c} e_1 \\ e_2 \\ e_3 \\ e_4 \\ e_5 \\ e_6 \\ e_7 \\ e_8 \\ e_9 \\ e_{10} \end{array} &
\begin{pmatrix}
(0.8,0.2) & (0.8,0.2) & (0.8,0.2) & (0,0) & (0,0) & (0,0) & (0,0) & (0,0) & (0.4,0.2) \\
(0,0) & (0,0) & (0,0) & (0.8,0.2) & (0.8,0.2) & (0.8,0.2) & (0,0) & (0,0) & (0.5,0.3) \\
(0,0) & (0,0) & (0,0) & (0,0) & (0,0) & (0.8,0.2) & (0.8,0.2) & (0.8,0.2) & (0.6,0.2) \\
(0.5,0.3) & (0.6,0.1) & (0,0) & (0.5,0.3) & (0.6,0.1) & (0.7,0.2) & (0.3,0.2) & (0,0) & (0.4,0.3) \\
(0.1,0.2) & (0.2,0.1) & (0.3,0.2) & (0.7,0.2) & (0.2,0.3) & (0.3,0.1) & (0.1,0.2) & (0,0) & (0.5,0.3) \\
(0,0) & (0,0) & (0.7,0.1) & (0,0) & (0.4,0.2) & (0.5,0.2) & (0.4,0.4) & (0.4,0.2) & (0.6,0.2) \\
(0.8,0.2) & (0,0) & (0,0) & (0.8,0.2) & (0,0) & (0,0) & (0.8,0.2) & (0,0) & (0.4,0.2) \\
(0.5,0.1) & (0.2,0.1) & (0,0) & (0.4,0.2) & (0.4,0.1) & (0,0) & (0,0) & (0.6,0.1) & (0.2,0.5) \\
(0,0) & (0,0) & (0,0) & (0.3,0.5) & (0.4,0.2) & (0.6,0.2) & (0,0) & (0.5,0.2) & (0.5,0.2) \\
(0.1,0.2) & (0.3,0.3) & (0.5,0) & (0,0) & (0.5,0.2) & (0,0) & (0,0) & (0.8,0.2) & (0.6,0.1)
\end{pmatrix}
\end{array}
$$

Atleast 3 months the patient is exposed to the CT Scan only in horizontal and vertical direction.His readings were as follows

$$
\overline{B} = \begin{array}{cc}
 & \begin{array}{ccccccccc} v_1 & v_2 & v_3 & v_4 & v_5 & v_6 & v_7 & v_8 & \varepsilon_B(e) \end{array} \\
\begin{array}{c} e_1 \\ e_2 \\ e_3 \\ e_7 \\ e_8 \\ e_9 \end{array} &
\begin{pmatrix}
(0.8,0.2) & (0.6,0.1) & (0.8,0.2) & (0,0) & (0,0) & (0,0) & (0,0) & (0,0) & (0.3,0.1) \\
(0,0) & (0,0) & (0,0) & (0.6,0.2) & (0.8,0.2) & (0.6,0.2) & (0,0) & (0,0) & (0.4,0.1) \\
(0,0) & (0,0) & (0,0) & (0,0) & (0,0) & (0.6,0.2) & (0.5,0.3) & (0.4,0.2) & (0.7,0.2) \\
(0.6,0.2) & (0,0) & (0,0) & (0.5,0.4) & (0,0) & (0.1,0.2) & (0.6,0.1) & (0,0) & (0.8,0.2) \\
(0,0) & (0.8,0.2) & (0,0) & (0,0) & (0.5,0.2) & (0,0) & (0,0) & (0.0.9) & (0.5,0.4) \\
(0,0) & (0,0) & (0.8,0.2) & (0,0) & (0,0) & (0,0) & (0,0) & (0.8,0.2) & (0.7,0.2)
\end{pmatrix}
\end{array}
$$

Here $Stab(\overline{A},\overline{B}) \cong .81 < \varepsilon = 0.90$. Hence (E,V) is not stable under $\overline{\mu}$ & $\overline{\gamma}$ with respect to the given $\varepsilon, \delta$ .This implies that there are some changes in the pixels which are evident from the first and second scan with respect to the horizontal and vertical directions. This suffices the concentration of doctor's towards the pixels present in the horizontal and vertical directions with regard to the growth of the tumor cells.

## 6. Conclusion

Similarity measure is an important tool for determining the degree of similarity between two object. In comparing two objects the stability of the objects will give some different perception to the investigation .In this paper ,we construct a complete Intuitionistic fuzzy hyper graph model for the image of CT scans which are taken from different time period and applied the concepts of similarity measures and stability in the model to interpret the results.

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