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An Introduction to Fuzzy Soft Digraph

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Abstract: *Fuzzy sets and soft sets are two different tools for representing uncertainty and vagueness. We introduce the notions of fuzzy soft digraphs, fuzzy soft walk, fuzzy soft trail in digraph and some operations in fuzzy soft in fuzzy soft digraph.*

Keywords: *fuzzy soft graph, fuzzy soft digraph, walk in fuzzy soft digraph, trail in fuzzy soft digraph, union and intersection in fuzzy soft digraph.*

I. Introduction

The Concept of soft set theory was initiated by Molodtsov [1] for dealing uncertainties. A Rosenfeld [2] developed the theory of fuzzy graphs in 1975 by considering fuzzy relation on fuzzy set, which was developed by Zadeh [3] in the year 1965. Some operations on fuzzy graphs are studied by Mordeson a C.S. Peng [4] .Later Ali et al. discussed about fuzzy sets and fuzzy soft sets induced by soft sets. M.Akram and S Nawaz [5] introduced fuzzy soft graphs in the year 2015. Sumit mohinta and T K samanta [6] also introduced fuzzy soft graphs independently. The notion of fuzzy soft graph and few properties related to it are presented in their paper. In this paper, fuzzy soft digraph, walk in fuzzy soft digraph, trail in fuzzy soft digraph and some operations are introduced.

II. Preliminaries

We now review some elementary concepts of digraph and fuzzy soft graph

Definition: 2.1

Let U be an initial universe set and E be the set of parameters. Let A $\subset E$, A pair (F,A) is called ***fuzzy soft set*** over U where F is a mapping given by F : A → I^U, where I^U denotes the collection of all fuzzy subsets of U.

Definition: 2.2

Let V be a nonempty finite set and $\sigma : V \rightarrow [\,0, 1]$. Again , let $\mu : V\ X\ V \rightarrow [0,1]$ such that $\mu(x, y) \leq \sigma(x) \wedge \sigma(y)$ for all $(x, y) \in V\ X\ V$. Then the pair $G = (\sigma , \mu)$ is called ***a fuzzy graph over the set V***. Here σ *and* μ are respectively called *fuzzy vertex and fuzzy edge* of the fuzzy graph G = (σ , μ)

Definition: 2.3

A fuzzy digraph $G_D = (\sigma_D , \mu_D)$ is a pair of function $\sigma_D : V \rightarrow [\,0, 1]$ and $\mu_D : V\ X\ V \rightarrow [0,1]$ Where $\mu_D(x, y) \leq \sigma_D(x) \wedge \sigma_D(y)$ for all $(x, y) \in V\ X\ V$ and μ_D is a set of fuzzy directed edges are called *fuzzy arcs*.

Definition: 2.4

The ***degree of any vertex*** $\sigma(x_i)$ of a fuzzy graph is sum of degree of membership of all those edges which are incident on a vertex $\sigma(x_i)$ and is denoted by $deg(\sigma(x_i))$.

Definition: 2.5

In a fuzzy digraph the number of arcs directed away from the vertex $\sigma(x)$is called the ***outdegree of vertex***, it is denoted by $od(\sigma(x))$. The number of arcs directed to the vertex $\sigma(x)$ is called ***indegree of vertex,*** it is denoted by $id(\sigma(x))$.

The ***degree of vertex*** $\boldsymbol{\sigma(x)}$ ***in a fuzzy digraph*** is deined to be $deg(\sigma(x)) = id(\sigma(x)) + od(\sigma(x))$.

Definition: 2.6

Let $G = (\sigma , \mu)$ be a fuzzy graph. The ***Order of G*** $= (\sigma , \mu)$ is defined as

$$O(G) = \sum_{u \in V} \sigma(u)$$

and ***the size of G*** $= (\sigma , \mu)$ is defined as

$$S(G) = \sum_{u,v \in V} \mu(u, v).$$

Definition: 2.7

A ***directed fuzzy walk*** in a fuzzy graph is an alternating sequence of vertices an edges, $x_0, e_1, x_1, e_2, \dots \dots \dots \dots .., e_n, x_n$ in which each edge e_i is x_{i-1}, x_i.

Definition : 2.8

A ***fuzzy path*** is a fuzzy walk in which all vertices are distinct.

Definition : 2.9

Let $G_1 = (\sigma_1 , \mu_1)$ and $G_2 = (\sigma_2 , \mu_2)$ be two fuzzy graphs over the set V. Then ***the union of*** G_1 *and* G_2 is another fuzzy graph $G_3 = (\sigma_3 , \mu_3)$ over the set V, where

$$\sigma_3 = \sigma_1 \cup \sigma_2 \quad \text{and} \quad \mu_3 = \mu_1 \cup \mu_2 ,$$

$$i.\text{e. } \sigma_3(x) = max\{ \sigma_1(x), \sigma_2(x)\} \ \forall x \in V$$

$$\text{and} \quad \mu_3(x, y) = max\{\mu_1(x, y), \mu_2(x, y)\} \ \forall x, y \in V.$$

Definition : 2.10

Let $G_1 = (\sigma_1 , \mu_1)$ and $G_2 = (\sigma_2 , \mu_2)$ be two fuzzy graphs over the set V. Then ***the intersection*** of G_1 *and* G_2 is another fuzzy graph $G_3 = (\sigma_3 , \mu_3)$ over the set V, where

$$\sigma_3 = \sigma_1 \cap \sigma_2 \quad \text{and} \quad \mu_3 = \mu_1 \cap \mu_2 ,$$

$$i.\text{e. } \sigma_3(x) = min\{ \sigma_1(x), \sigma_2(x)\} \ \forall x \in V$$

$$\text{and} \quad \mu_3(x, y) = min\,\{\mu_1(x, y), \mu_2(x, y)\} \ \forall x, y \in V.$$

III. Fuzzy Soft Digraph

We now introduce some basic concepts of fuzzy soft digraph

Definition: 3.1

Let V = { $x_1, x_2, x_3, x_4, x_5, \dots \dots x_n$ } (non empty set), E(parameters set) and A ≤ E

Also let

(i) $\rho_D : A \to F(V)$ (collection of all fuzzy subsets in V)

$e \longmapsto \rho_D^{(e)} = \rho_D^e \ (say)$

And $\rho_D^e : V \to [0,1]$ $\quad x_i \longmapsto \rho_D^e(x_i)$

(A, ρ_D) : *Fuzzy soft vertex*

(ii) $\mu_D : A \to F(V\ X\ V)$ (Collection of all Fuzzy subsets in V X V)

$e \longmapsto ⍰_D^{(e)} = ⍰_D^e \ (say)$

And $⍰_D^e : V\ X\ V \to [0,1]$ $\quad (x_i , x_j) \longmapsto ⍰_D^e(x_i , x_j)$

And $⍰_D^e$ is a set of fuzzy directed edges are called *fuzzy arcs*.

(A, μ_D) : *Fuzzy soft edge*

Then ((A, ρ_D) , (A, μ_D)) is called fuzzy soft digraph iff $⍰_D^e\ (x_i , x_j) \leq \rho_D^e(x_i) \wedge \rho_D^e(x_j)$

$\forall$ e $\in A$ *and* $\forall i, j = 1,2,3, \dots \dots .n$ *and this* $\boldsymbol{fuzzy\ soft\ digraph}$ is denoted by $D_{A,V}$

Example: 3 .1

Consider a fuzzy soft digraph $D_{A,V}$ where V = { x_1, x_2, x_3, x_4 } *and* $E = \{ e_1, e_2, e_3 \}$ $D_{A,V}$ Described by Table 3.1 and $⍰_D^e\ (x_i , x_j) = 0 \ for\ all\ (x_i , x_j) \in V\ X\ V\ /\ \{(x_1 , x_2), (x_2, x_3),$ $(x_3 , x_4) , (x_4 , x_1)$ } And for all e $\in E$

Table 3.1

ρ_D	x_1	x_2	x_3	x_4
e_1	0.2	0.8	0.6	0.4
e_2	0.1	0.3	0.7	0.5
e_3	0.4	0.5	0.9	0

μ_D	(x_1 , x_2)	(x_2, x_3)	(x_3 , x_4)	(x_4 , x_1)
e_1	0.1	0.5	0.4	0.2
e_2	0.1	0.2	0.4	0.1
e_3	0.2	0.4	0	0

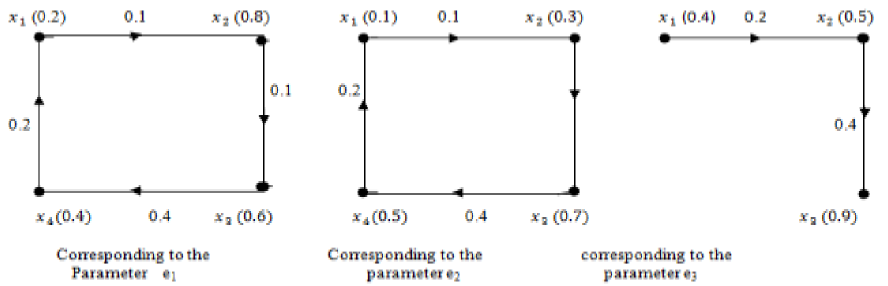


Fig. 3.1 Fuzzy Soft Digraph $D_{A,V}$

Definition: 3.2

Let $D_{A,V}$ = $((A, \rho_D), (A, \mu_D))$ be a Fuzzy Soft digraph . The ***degree of a vertex 'u'*** is defined as

$$deg_{D_{A,V}} = \sum_{e \in A} \left(\sum_{u \in V} (od(u) + id(u)) \right)$$

Definition: 3.3

Let $D_{A,V}$ = $((A, \rho_D), (A, \mu_D))$ be a Fuzzy Soft digraph . Then ***the Order of $D_{A,V}$*** is defined as

$$O(D_{A,V}) = \sum_{e \in A} \left(\sum_{x_i \in V} \rho_D^e(x_i) \right)$$

Definition: 3.4

The ***Size of $D_{A,V}$*** is defined as

$$S(D_{A,V}) = \sum_{e \in A} \left(\sum_{x_i, x_j \in V} \mu_D^e(x_i, x_j) \right)$$

Example from the above Fig 3.1

$D_{A,V}$	$od(x_1) + id(x_1)$	$od(x_2) + id(x_2)$	$od(x_3) + id(x_3)$	$od(x_4) + id(x_4)$
e_1	0.1 + 0.2 = 0.3	0.5 + 0.1 = 0.6	0.4 + 0.5 = 0.9	0.1 + 0.2 = 0.3
e_2	0.1 + 0.1` = 0.2	0.2 + 0.1 = 0.3	0.4 + 0.2 = 0.6	0.1 + 0.4 = 0.5
e_3	0.2 + 0 = 0.2	0.4 + 0.2 = 0.6	0 + 0.4 = 0.4	0 + 0 = 0
Deg	*Deg*(x_1) = 0.7	*Deg*(x_2) = 1.5	*Deg*(x_3) = 1.9	*Deg*(x_4) = 0.8

The *degree of the vertex* x_i is

$$deg_{D_{A,V}}(x_i) = \sum_{e \in A} \left(\sum_{u \in V} (od(u) + id(u)) \right)$$

Therefore, $deg_{D_{A,V}}(x_1) = 0.7$

$deg_{D_{A,V}}(x_2) = 1.5$

$deg_{D_{A,V}}(x_3) = 1.9$

$deg_{D_{A,V}}(x_4) = 0.8$

The *Order of fuzzy soft digraph* $D_{A,V}$ is

$$O(D_{A,V}) = \sum_{e \in A} \left(\sum_{x_i \in V} \rho_D^e(x_i) \right)$$

$$= (0.2 + 0.8 + 0.6 + 0.4) + (0.1 + 0.3 + 0.7 + 0.5) + (0.4 + 0.5 + 0.9)$$

$$= 2.0 + 1.6 + 1.8$$

Therefore, $O(D_{A,V}) = 5.4$

The *Size of fuzzy soft digraph* $D_{A,V}$ is

$$S(D_{A,V}) = \sum_{e \in A} \left(\sum_{x_i, x_j \in V} \mu_D^e(x_i, x_j) \right)$$

(i.e) Size = Sum of all the fuzzy arcs

$$= (0.1 + 0.5 + 0.4 + 0.2) + (0.1 + 0.2 + 0.4 + 0.1) + (0.2 + 0.4)$$

$$= 1.2 + 0.8 + 0.6$$

Therefore, $S(D_{A,V}) = 2.6$

Definition: 3.5

A fuzzy soft arc joining a fuzzy soft vertex to itself is called ***a fuzzy soft loop in digraph***

(i.e) id = od

Definition: 3.6

Let $D_{A,V}$ = $((A, \rho_D), (A, \mu_D))$ be a fuzzy soft digraph. If for all $e \in A$ there is more than one fuzzy soft arc joining two fuzzy soft vertices, then the fuzzy soft digraph is called **a *fuzzy soft pseudo digraph*** an these arcs are called ***fuzzy soft multiple arcs.***

Definition: 3.7

Let $D_{A,V}$ = $((A, \rho_D), (A, \mu_D))$ be a *fuzzy soft simple digraph* if it has neither fuzzy soft loops nor fuzzy soft multiple arcs for all $e \in A$

Example: 3.2

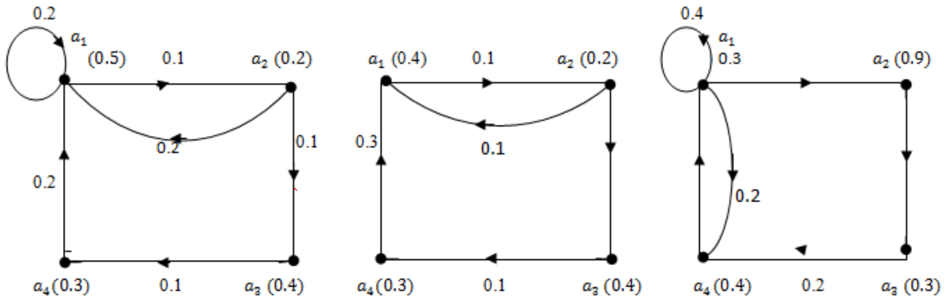
Consider a fuzzy soft digraph $D_{A,V}$ where V = $\{a_1, a_2, a_3, a_4\}$ $and\ E = \{e_1, e_2, e_3\}$ $D_{A,V}$ described by Table 3.2 and $\mu_D^e(x_i, x_j) = 0\ for\ all\ (x_i, x_j)$ $\in V\ X\ V\ /\ \{(a_1, a_2), (a_2, a_3), (a_3, a_4), (a_4, a_1), (a_2, a_1), (a_1, a_4),$

(a_1, a_1) } and for all e ∈ E

Table 3.2

ρ_D	a_1	a_2	a_3	a_4
e_1	0.5	0.2	0.4	0.3
e_2	0.4	0.7	0.6	0.5
e_3	0.5	0.9	0.3	0.4

μ_D	(a_1, a_2)	(a_2, a_3)	(a_3, a_4)	(a_4, a_1)	(a_2, a_1)	(a_1, a_4)	(a_1, a_1)
e_1	0.1	0.2	0.1	0.2	0.2	0.2	0
e_2	0.1	0.2	0.1	0.1	0	0.1	0
e_3	0.3	0.2	0.2	0.3	0.4	0	0.2



Corresponding to the Parameter e_1 Corresponding to the parameter e_2 corresponding to the parameter e_3

Fig 3.2 Pseudo Fuzzy Soft Digraph $D_{A,V}$

The figure above contains a fuzzy soft loops corresponding to parameters e_1 and e_3.It also contains fuzzy soft multiple arcs corresponding to the parameter e_1, e_2 and e_3. Therefore, $D_{A,V}$ is Pseudo Fuzzy soft digraph, but it is not simple fuzzy soft digraph.

Definition: 3.8

A fuzzy soft walk in $D_{A,V}$ = ((A, ρ_D) , (A, μ_D)) is an alternating sequence of

W = $\rho_D^e(x_1)\mu_D^e(a_1)\rho_D^e(x_2)\mu_D^e(a_2)\rho_D^e(x_3)\mu_D^e(a_4)$ ... ... $\rho_D^e(x_{k-1})\mu_D^e(a_{k-1})\rho_D^e(x_k)$

of fuzzy soft vertices $\rho_D^e(x_i)$ and fuzzy soft directed edges $\mu_D^e(a_i)$ from D such tha the tail of $\mu_D^e(a_i)$ is $\rho_D^e(x_i)$ and the head of $\mu_D^e(a_i)$ is $\rho_D^e(x_{i+1})$ for every I = 1,2,3,………… k-1.

A fuzzy soft walk is *closed* if $\rho_D^e(x_1) = \rho_D^e(x_k)$ and *open* otherwise.

We say that W is fuzzy soft walk from $\rho_D^e(x_1)$ to $\rho_D^e(x_k)$ or an μ_D^e (x_1, x_k) - fuzzy soft walk.

Definition: 3.9

The *length* of the fuzzy soft walk in D is

$$L_D(W) = \sum_{e \in A} \Big(\sum_{x_i, x_j \in V} \mu_D^e(a_i) \Big) \quad \text{where } a_i = (\rho_D^e(x_i), \rho_D^e(x_j))$$

Example: 3.3

Consider the V = { x_1, x_2, x_3, x_4, x_5 } *and* $E = \{ e_1, e_2, e_3, e_4 \}$. Let $A = \{ e_1, e_2, e_3 \}$ $D_{A,V}$ defined by Table 3.3 and $\mu_D^e(x_i, x_j) = 0$ *for all* $(x_i, x_j) \in V \, X \, V$ / {$(x_1, x_2), (x_2, x_5)$, $(x_5, x_4), (x_5, x_1), (x_4, x_3), (x_3, x_2), (x_3, x_5)$ } and for all e ∈ A

Table 3.3

ρ_D	x_1	x_2	x_3	x_4	x_5
e_1	0.1	0.2	0.8	0.2	0.3
e_2	0.8	0.3	0.3	0.9	0.9
e_3	0.6	0.8	0.7	0	0.5

μ_D	(x_1, x_2) (a_1)	(x_2, x_5) (a_6)	(x_5, x_4) (a_4)	(x_5, x_1) (a_5)	(x_4, x_3) (a_3)	(x_3, x_2) (a_2)	(x_3, x_5) (a_7)
e_1	0.1	0.2	0.2	0.2	0.1	0.4	0.2
e_2	0.2	0.1	0.7	0.6	0.2	0.1	0.2
e_3	0.5	0.2	0	0.3	0	0.4	0.3

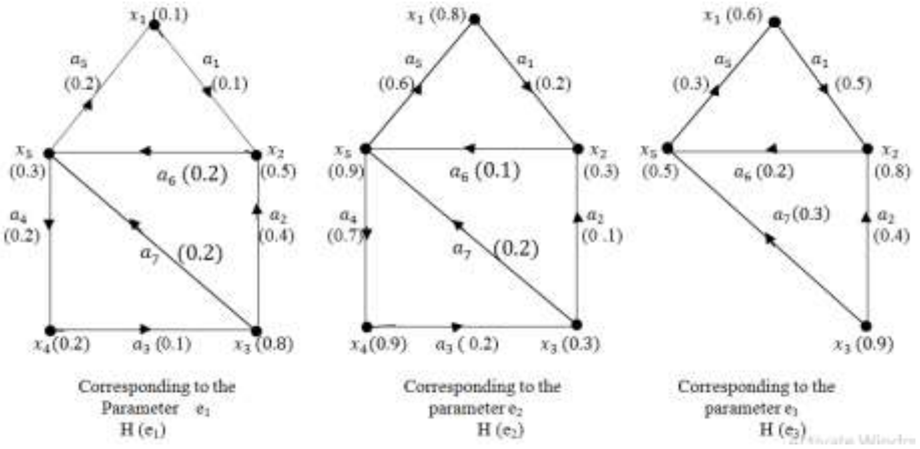
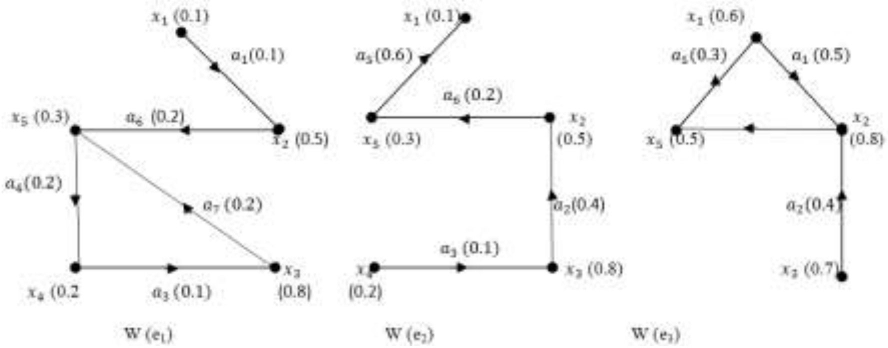


Fig 3. 3 D = { H (e_1) , H(e_2) , H(e_3) } is *fuzzy soft digraph.*



Fig, 3.4

W(D) = { W(e_1) , W(e_2) , W(e_3) } is the *fuzzy soft walk* in digraph.

The *length of the fuzzy soft walk*

$$L_D(W) = \sum_{e \in A} \Big(\sum_{x_i, x_j \in V} \mu_D^e(a_i) \Big)$$

$$= 0.8 + 1.3 + 1.4$$

$$L_D(W) = 3.5$$

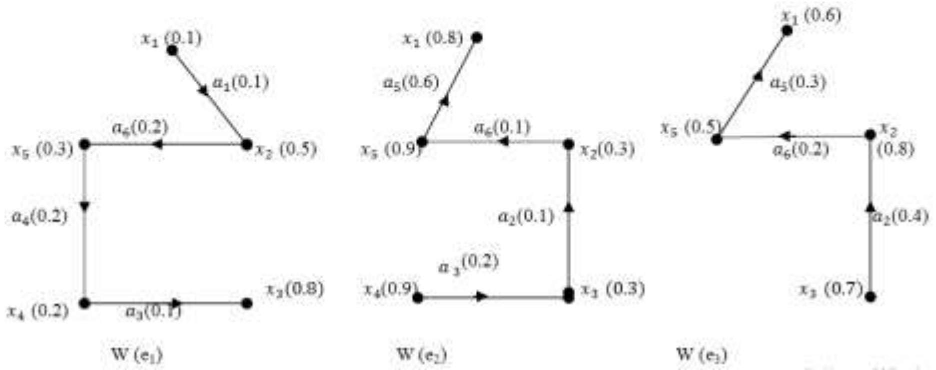
Definition: 3.10

If the fuzzy soft directed edges are distinct in a fuzzy soft walk is called *a trail of fuzzy soft digraph*.

Definition: 3.11

If the fuzzy soft vertices are distinct in a fuzzy soft walk is called *a path of fuzzy soft digraph*.

From the above Example .3.3



Fig, 3.5

W(D) = { W(e_1) , W(e_2) , W(e_3) } is the *fuzzy soft path* in digraph.

IV. Operations On Fuzzy Soft Digraph

We now introduce some basic operations on fuzzy soft digraph

Definition: 4.1

Let V_1 , V_2 ⊂ V and A , B ⊂ E then the union of two fuzzy soft digraphs .

D^1_{A,V_1} = ((A, $\rho^e_{D^1}$), (A, $\mu^e_{D^1}$)) and

D^2_{B,V_2} = ((B, $\rho^e_{D^2}$), (B, $\mu^e_{D^2}$)) is defined to be

D^3_{C,V_3} = ((C, $\rho^e_{D^3}$), (C, $\mu^e_{D^3}$)) say.

Where C = A U B , $V_3 = V_1 \ U \ V_2$

$$\rho^e_{D^3}(x_i) = \begin{cases} \rho^e_{D^1}(x_i) & \forall x_i \in V_1 - V_2 \ \& \ e \in A - B \\ 0 & \forall x_i \in V_2 - V_1 \ \& \ e \in A - B \\ \rho^e_{D^1}(x_i) & \forall x_i \in V_1 \cap V_2 \ \& \ e \in A - B \\ \rho^e_{D^2}(x_i) & \forall x_i \in V_2 - V_1 \ \& \ e \in B - A \\ 0 & \forall x_i \in V_1 - V_2 \ \& \ e \in B - A \\ \rho^e_{D^2}(x_i) & \forall x_i \in V_1 \cap V_2 \ \& \ e \in B - A \\ max\{\rho^e_{D^1}(x_i) \cup \rho^e_{D^2}(x_i)\} & \forall x_i \in V_1 \cap V_2 \ \& \ e \in A \cap B \\ \rho^e_{D^1}(x_i) & \forall x_i \in V_1 - V_2 \ \& \ e \in A \cap B \\ \rho^e_{D^2}(x_i) & \forall x_i \in V_2 - V_1 \ \& \ e \in A \cap B \end{cases}$$

And

$$\mu^{e}_{D^3}(x_i, x_j) = \begin{cases} \begin{cases} \mu^{e}_{D^1}(x_i, x_j) & \text{if } (x_i, x_j) \in (V_1 X V_1) - (V_2 X V_2) \ \& \ e \in A - B \\ 0 & \text{if } (x_i, x_j) \in (V_2 X V_2) - (V_1 X V_1) \ \& \ e \in A - B \\ \mu^{e}_{D^1}(x_i, x_j) & \text{if } (x_i, x_j) \in (V_1 X V_1) \cap (V_2 X V_2) \ \& \ e \in A - B \end{cases} \\ \begin{cases} \mu^{e}_{D^2}(x_i, x_j) & \text{if } (x_i, x_j) \in (V_2 X V_2) - (V_1 X V_1) \ \& \ e \in B - A \\ 0 & \text{if } (x_i, x_j) \in (V_1 X V_1) \cap (V_2 X V_2) \ \& \ e \in B - A \\ \mu^{e}_{D^2}(x_i, x_j) & \text{if } (x_i, x_j) \in (V_1 X V_1) \cap (V_2 X V_2) \ \& \ e \in B - A \end{cases} \\ \begin{cases} \text{Max } \{ \mu^{e}_{D^1}(x_i, x_j) \cup \mu^{e}_{D^2}(x_i, x_j) \} & \\ & \text{if } (x_i, x_j) \in (V_1 X V_1) \cap (V_2 X V_2) \ \& \ e \in A \cap B \\ \mu^{e}_{D^1}(x_i, x_j) & \text{if } (x_i, x_j) \in (V_1 X V_1) - (V_2 X V_2) \ \& \ e \in A \cap B \\ \mu^{e}_{D^2}(x_i, x_j) & \text{if } (x_i, x_j) \in (V_2 X V_2) - (V_1 X V_1) \ \& \ e \in A \cap B \end{cases} \end{cases}$$

Where $\mu^{e}_{D^1}(x_i, x_j)$, $\mu^{e}_{D^2}(x_i, x_j)$ and $\mu^{e}_{D^3}(x_i, x_j) = \mu^{e}_{D^1} \cup \mu^{e}_{D^2}$ are the set of fuzzy directed edges are called fuzzy arcs.

Example: 4.1

Consider V = $\{ x_1, x_2, x_3, x_4 \}$ $and\ E = \{ e_1, e_2, e_3 \}$. Let $V_1 = \{ x_1, x_2, x_3 \}$, A = $\{ e_1, e_2 \}$, $V_2 = \{ x_2, x_3, x_4 \}$ & $B = \{ e_2, e_3 \}$.D^1_{A,V_1} is defined $by\ Table$ 4.1 and $\mu^{e}_{D^1}(x_i, x_j) = 0$ for all $(x_i, x_j) \in (V_1 X V_1) \setminus (x_1, x_2), (x_2, x_3), (x_3, x_1) \}$ and for all e $\in A$.
D^2_{B,V_2} is defined by Table 4.2 and
$\mu^{e}_{D^2}(x_i, x_j) = 0$ for all $(x_i, x_j) \in (V_2 X V_2) \setminus \{ (x_2, x_3), (x_3, x_4), (x_3, x_2), (x_2, x_4), (x_4, x_2) \}$ and for all e $\in B$. Then the Union of D^1_{A,V_1} and D^2_{B,V_2} is D^3_{C,V_3} given by the Table 4.3 and $\mu^{e}_{D^3}(x_i, x_j) = 0$ for all $(x_i, x_j) \in (V_3 X V_3) \setminus \{ (x_2, x_3), (x_3, x_4), (x_3, x_2), (x_3, x_1), (x_1, x_2), (x_2, x_4), (x_4, x_2) \}$ and for all e $\in C$.

Table 4.1

ρ_{D^1}	x_1	x_2	x_3
e_1	0.5	0.8	0.4
e_2	0.8	0.2	0.9

μ_{D^1}	(x_1, x_2)	(x_2, x_3)	(x_3, x_1)
e_1	0.4	0.3	0.2
e_2	0.1	0.2	0

Table 4.2

ρ_{D^2}	x_2	x_3	x_4
e_2	0.6	0.5	0.4
e_3	0.7	0.5	0.4

μ_{D^2}	(x_2, x_3)	(x_3, x_2)	(x_3, x_4)	(x_4, x_2)	(x_2, x_4)
e_2	0	0.4	0.2	0.2	0
e_3	0.3	0	0	0	0.2

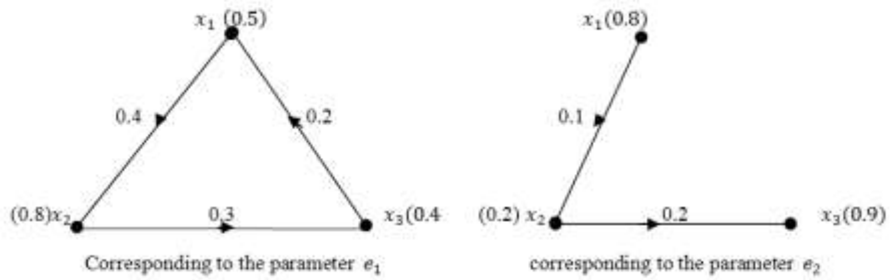


Fig 4.1 $\boldsymbol{D^1_{A,V_1}}$

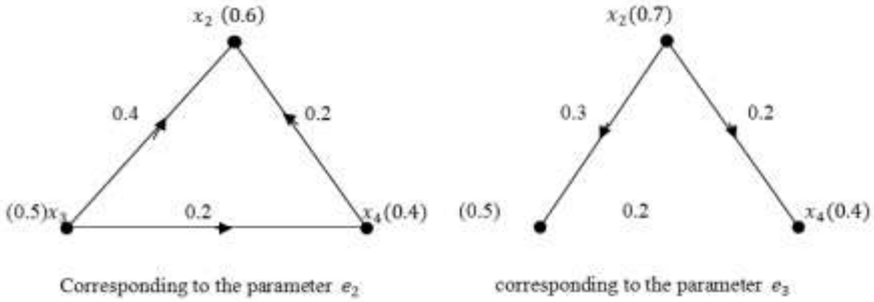


Fig 4.2 $\boldsymbol{D^2_{B,V_2}}$

Table 4.3

ρ_D	x_1	x_2	x_3	x_4
e_1	0.2	0.8	0.6	0
e_2	0.8	0.6	0.9	0.4
e_3	0.7	0.5	0.4	0

μ_D	(x_1, x_2)	(x_2, x_3)	(x_3, x_2)	(x_3, x_1)	(x_3, x_4)	(x_4, x_2)	(x_2, x_4)
e_1	0.4	0.3	0	0.2	0	0	0
e_2	0.1	0.2	0.4	0	0.2	0.2	0
e_3	0	0.3	0	0	0	0	0.2

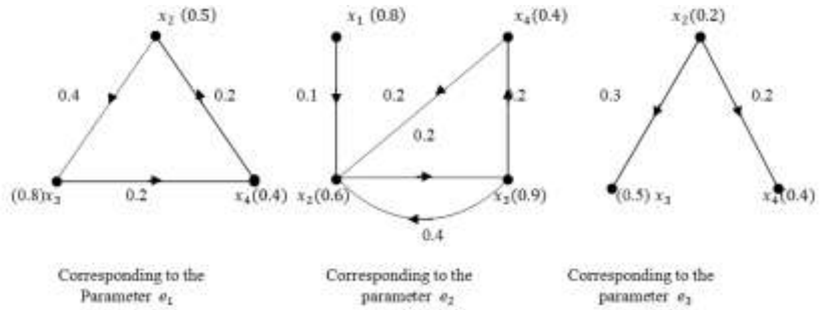


Fig 4.3 D^3_{C,V_3}

Definition: 4. 2

Let V_1 , V_2 ⊂ V and A , B ⊂ E then the Intersection of two fuzzy soft digraphs .

D^1_{A,V_1} = ((A, $\rho^e_{D^1}$), (A, $\mu^e_{D^1}$)) and

D^2_{B,V_2} = ((B, $\rho^e_{D^2}$), (B, $\mu^e_{D^2}$)) is defined to be

D^3_{C,V_3} = ((C, $\rho^e_{D^3}$), (C, $\mu^e_{D^3}$)) say.

Where C = A ∩ B , $V_3 = V_1 \cap V_2$ and

$$\rho^e_{D^3}(x_i) = \rho^e_{D^1}(x_i) \cap \rho^e_{D^2}(x_i) \text{ for all } x_i \in V_3 \text{ and } e \in C, \text{and}$$

$$\mu^e_{D^3}(x_i, x_j) = \mu^e_{D^1}(x_i, x_j)\ \mu^e_{D^2}(x_i, x_j) \text{ if } (x_i, x_j) \in V_3 \ \&\ e \in C.$$

Example : 4.2

Consider V = { x_1, x_2, x_3, x_4 } $and\ E = \{e_1, e_2, e_3\}$. Let V_1 = { x_1, x_2, x_3} ,$A = \{e_1, e_2\}$, V_2 = { x_2, x_3, x_4 } & $B = \{e_2, e_3\}$. $D^1_{A,V_1}$is defined $by\ Table$ 4.4 and $\mu^e_{D^1}(x_i, x_j) = 0$ for all $(x_i, x_j) \in (V_1 X\ V_1)\backslash(x_1, x_2), (x_2, x_3), (x_3, x_1)$ } and for all e ∈ A. D^2_{B,V_2} is defined by Table 4.5 and $\mu^e_{D^2}(x_i, x_j) =$

0 for all $(x_i, x_j) \in (V_2 X V_2)\backslash \{(x_2, x_3), (x_2, x_4), (x_4, x_2)\}$ and for all e $\in B$. So $V_3 = \{(x_2, x_3)\} and\ C = \{e_2\}$.

Then the intersection of D^1_{A,V_1} and D^2_{B,V_2} is D^3_{C,V_3} given by the Table 4.6 and $\mu^e_{D^3}(x_i, x_j) = 0$ for all $(x_i, x_j) \in (V_3 X V_3)\backslash \{(x_2, x_2), (x_3, x_2), (x_3, x_3)\}$ and for all e $\in C$.

Table 4.4

ρ_{D^1}	x_1	x_2	x_3
e_1	0.7	0.5	0.3
e_2	0.5	0.7	0.6

μ_{D^1}	(x_1, x_2)	(x_2, x_3)	(x_3, x_1)
e_1	0.3	0	0.2
e_2	0.4	0.3	0

Table 4.5

ρ_{D^2}	x_2	x_3	x_4
e_2	0.8	0.6	0.4
e_3	0.5	0.4	0.3

μ_{D^2}	(x_2, x_3)	(x_4, x_2)	(x_2, x_4)
e_2	0.5	0..2	0
e_3	0.3	0	0.1

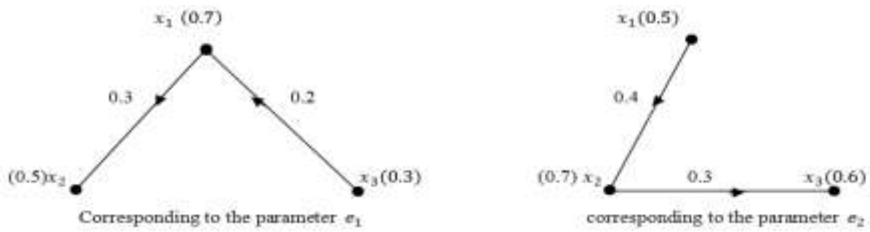


Fig 4.4 $\boldsymbol{D^1_{A,V_1}}$

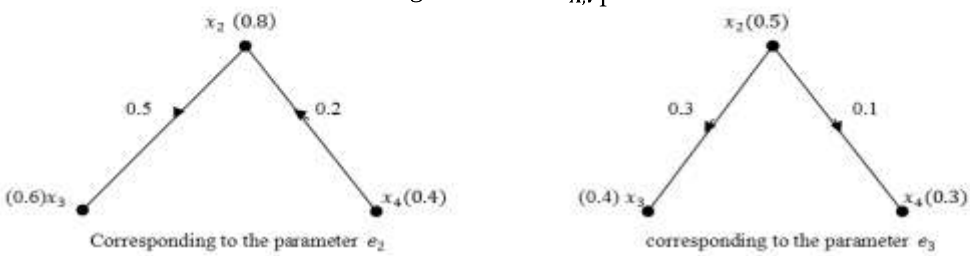


Fig 4.5 $\boldsymbol{D^2_{B,V_2}}$

Table 4.6

ρ_{D^3}	x_2	x_3
e_2	0.7	0.6

μ_{D^3}	(x_2, x_3)
e_2	0.3

Fig 4.6 $\boldsymbol{D^3_{C,V_3}}$

V. Conclusion

Finally, we have analyzed some concepts of fuzzy soft digraph, union and intersection of fuzzy soft digraph. In future it can be applied to real applications in mobile networks, one way transportation problem and decision making problems.

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