A STUDY ON SUICIDE PROBLEM USING COMBINED OVERLAP BLOCK NEUTROSOPHIC COGNITIVE MAPS

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Abstract.

The autors study to find out **reasons for suicide using Overlap Block Neutrosophic Cognitive Maps** (*COBNCMs*) defined by Florentin Smarandache and W. B. Vasantha Kandasamy.

The **Combined Overlap Block Neutrosophic Cognitive Maps** defined in this method becomes effective when the number of concepts can be grouped and are large in numbers.

This presentation has three sections.

The first and second sections recall the fundamentals of **Neutrosophic Cognitive Maps (*NCMs*), Combined Block Neutrosophic Cognitive Maps (*CBNCMs*)**, and **Combined Overlap NCMS**, respectively.

The third section gives the **adaptation of Overlap *NCM* to the problem**.

I. Fundamentals of Neutrosophic Cognitive Maps (NCMS) and Overlap Block NCMs.

Definition 1.1

Neutrosophic Cognitive Map is the generalization of Fuzzy Cognitive Map.

A Neutrosophic Cognitive Map (*NCM*) is a neutrosophic directed graph with concepts like policies, events etc. as nodes and causalities or indeterminates as edges.

It represents the causal relationship between concepts.

Definition 1.2

NCMs with edge weight from {-1, 0, 1, I } are called *simple NCMs*.

Definition 1.3

Let C_1, C_2, ., C_n be the nodes of a *NCM*.

Let the neutrosophic matrix $N(E)$ be defined as $N(E) = (e_{ij})$ where e_{ij} is the weight of the directed edge $C_i\ C_j$, where $e_{ij} \in \{0, 1, -1, I\}$.

$N(E)$ is called the *neutrosophic adjacency matrix of the NCM*.

Definition 1.4

Let C_1, C_2, ., C_n be the nodes of the *NCM*. Let $A = (a_1, a_2, ., a_n)$ where $a_i \in \{0, 1, I\}$.

A is called the *instantaneous state neutrosophic vector* and it denotes the *ON* , *OFF* , *INDETERMINATE* state position of the node at an instant,

- ❑ $a_i = 0$ if a_i is *off* (no effect)
- ❑ $a_i = 1$ if a_i is *on* (has effect)
- ❑ $a_i = I$ if a_i is *indeterminate* (effect cannot be determined),

for $i = 1, 2, ., n.$

Definition 1.5

Let C_1, C_2, ., C_n be the nodes of the *FCM*.

Let C_1C_2, C_2C_3, …, $C_{n-1}C_n$, be the directed edges of the *NCM*.

Then the edges form a directed cycle.

A *NCM* is said to be *cyclic* if it possesses a directed cycle.

A *NCM* is said to be *acyclic* if it does not possess any directed cycle.

Definition 1.6

A *NCM* with cycles is said to have a feedback.

When there is a feedback in the *NCM,* i.e. when the causal relations flow through a cycle in a revolutionary manner, the *NCM* is called a dynamical system.

Definition 1.7

Let C_1C_2, C_2C_3, …, $C_{n-1}C_n$, be the directed cycle, when C_i is switched *on* and if the causality flow through the edges of a cycle and if it again causes C_i, we say that the dynamical system goes round and round.

This is true for any node C_i, for $i = 1,2, ., n$.

The equilibrium state for this dynamical system is called the *hidden pattern*.

Definition 1.8

If the equilibrium state of a dynamical system is a unique state vector, then it is called a *fixed point*.

Consider the *NCM* with C_1, C_2, ., C_n as nodes.

For example, let us start the dynamical system by switching on C_1.

Let us assume that the *NCM* settles down with C_1 and C_n *on*, i.e. the state vector remain as $(1,0, … … 0, 1)$.

This neutrosophic state vector $(1,0, … … 0, 1)$ is called the fixed point.

Definition 1.9

If the *NCM* settles with a neutrosophic state vector repeating in the form

$$A_1 \rightarrow A_2 \rightarrow .... \rightarrow A_i \rightarrow A_1,$$

then this equilibrium is called a limit cycle of the *NCM*.

Definition 1.10

Let *P* be the problem under investigation.

Suppose let $\{C_1, C_2, ., C_n\}$ be *n* concepts associated with *P* (*n* very large).

Now divide the number of concepts $\{C_1, C_2, ., C_n\}$ into classes $S_1, ..., S_t$ where the classes are such that

$$(1)\ S_i \cap S_{i+1} \neq \emptyset \text{ where } (i = 1,2,...,t-1)$$

$$(2)\ U\, S_i = \{\ C_1, C_2, ...,C_n\ \}$$

$$(3)\ |S_i| \neq |S_j| \text{ if } i \neq j \text{ in general.}$$

Now we obtain the *NCM* associated with each of the classes $S_1, \ldots, S_t$.

We determine the relational matrix associated with each S_i.

Using these matrices we obtain a $n \times n$ matrix.

This $n \times n$ matrix is the matrix associated with the Combined Overlap Block NCM (*COBNCM*) of blocks of same sizes.

Definition 1.11
Finite number of *NCMs* can be combined together to produce the joint effect of all *NCMs*.

If $N(E_1), N(E_2), ., N(E_p)$ be the neutrosophic adjacency matrices of a *NCM* with nodes $C_1, C_2, ., C_n$ then the combined *NCM* is got by adding all the neutrosophic adjacency matrices $N(E_1), ., N(E_p)$.

The combined *NCMs* adjacency neutrosophic matrix is denoted by $N(E) = N(E_1) + N(E_2) + \ldots + N(E_p)$.

II. Problem definition and Justification for using Overlap Block *NCM* Model.

Suicide is one of the leading cause of death in the world.

Suicide is defined as deliberate killing of oneself.

The purpose of study is to identify the risk groups.

Suicides are most likely to occur during the periods of socio economic, family and individual crisis.

Suicide prevention is an umbrella term for the collection of efforts of local citizen organizations, mental health practitioners and related professionals to reduce the incidence of suicide through the preventive and proactive measures.

Moreover the data is an unsupervised one and also there is uncertainty and indeterminacy in the concepts.

Hence, **Neutrosophic tool alone has the capacity to analyze these concepts.**

III. Adaption of Overlap Block *NCM* to the problem.

Using the linguistic questionnaire and the experts opinion we have taken the following eight concepts $\{C_1, C_2, ..., C_8\}$.

The following concepts are taken as the main nodes for our problem.

C_1 – Poverty and unmanageable living cost (Economic Crisis).
C_2 - Working hours more with poor salary.
C_3 - Lack of commitment from the breadwinners.
C_4 – Failure in business.
C_5 – Inability to deal with debt trap and torture from "kanduvattikarars" (usurers).
C_6 – Government indifferences.
C_7 – Stress from mental, sexual and physical torture in the working places.
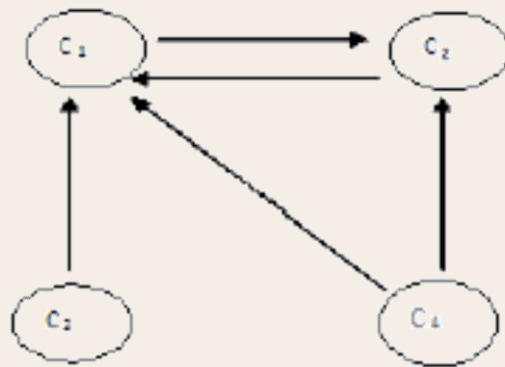**C_8 – Lack of counselors to help persons out of depression.**

Now we proceed on to apply the effect of combined overlap block *NCM* of equal length.

Let us consider the eight concepts $\{C_1, C_2, ..., C_8\}$.

We divide these concepts into cyclic way of classes, each having just four concepts in the following way.

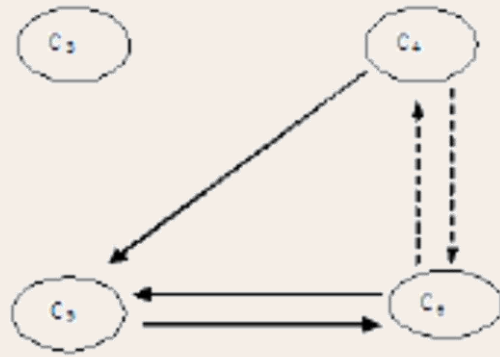$$S_1 = \{C_1, C_2, C_3, C_4, \}, \ S_2 = \{C_3, C_4, C_5, C_6\}, \ S_3 = \{C_5, C_6, C_7, C_8, \}, \ S_4 = \{C_7, C_8, C_1, C_2\}.$$

The directed graph and the relation matrix for the class $S_1 = \{C_1, C_2, C_3, C_4\}$ given by the expert is as follows.


$$
\begin{array}{c}
\quad\quad C_1 \quad C_2 \quad C_3 \quad C_4 \\
\begin{array}{c}
C_1 \\
C_2 \\
C_3 \\
C_4
\end{array}
\left[
\begin{array}{cccc}
0 & 1 & 0 & 0 \\
1 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 \\
1 & 1 & 0 & 0
\end{array}
\right]
\end{array}
$$

The directed graph and the relation matrix for the class $S_2 = \{C_3, C_4, C_5, C_6\}$ given by the expert is as follows.

$$
\begin{array}{c c}
 & \begin{array}{cccc} C_3 & C_4 & C_5 & C_6 \end{array} \\
\begin{array}{c} C_3 \\ C_4 \\ C_5 \\ C_6 \end{array} &
\left[\begin{array}{cccc}
0 & 0 & 0 & 0 \\
0 & 0 & 1 & I \\
0 & 0 & 0 & 1 \\
0 & I & 1 & 0
\end{array} \right]
\end{array}
$$

The directed graph and the relation matrix for the class $S_3 = \{C_5, C_6, C_7, C_8\}$ given by the expert is as follows.
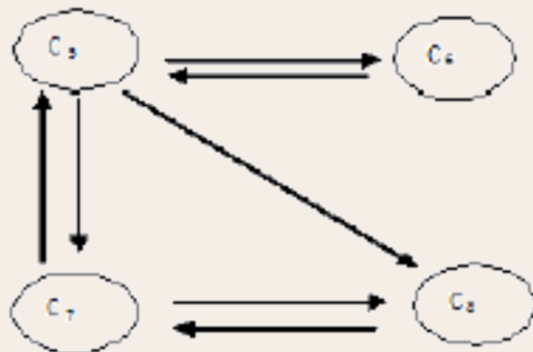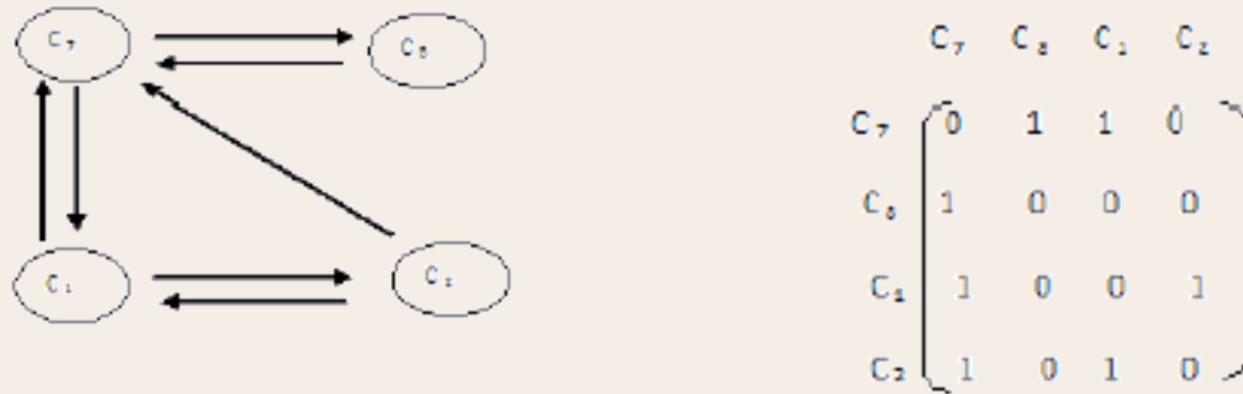

$$
\begin{array}{c c}
 & \begin{array}{cccc} C_5 & C_6 & C_7 & C_8 \end{array} \\
\begin{array}{c} C_5 \\ C_6 \\ C_7 \\ C_8 \end{array} &
\left[\begin{array}{cccc}
0 & 1 & 1 & 1 \\
1 & 0 & 0 & 0 \\
1 & 0 & 0 & 1 \\
0 & 0 & 1 & 0
\end{array} \right]
\end{array}
$$

The directed graph and the relation matrix for the class $S_4 = \{C_7, C_8, C_1, C_2\}$. given by the expert is as follows.

$$
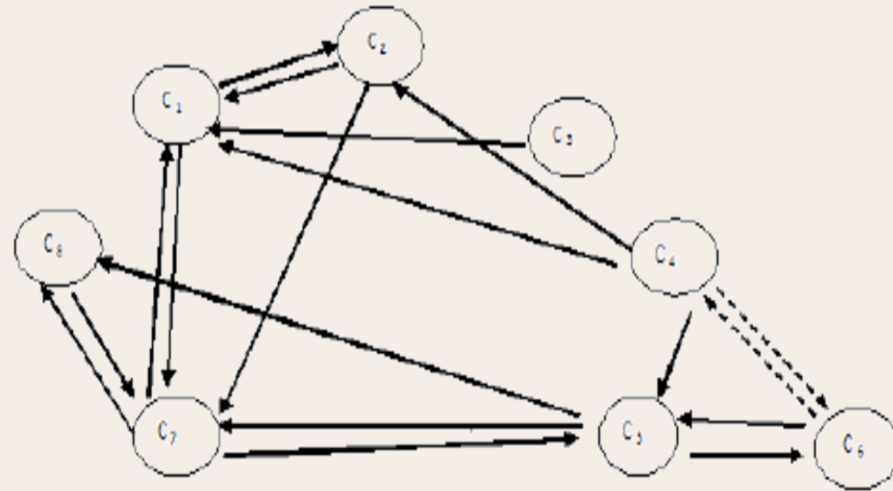\begin{array}{c}
\quad\quad C_7 \quad C_8 \quad C_1 \quad C_2 \\
\begin{array}{c}
C_7 \\
C_8 \\
C_1 \\
C_2
\end{array}
\left(
\begin{array}{cccc}
0 & 1 & 1 & 0 \\
1 & 0 & 0 & 0 \\
1 & 0 & 0 & 1 \\
1 & 0 & 1 & 0
\end{array}
\right)
\end{array}
$$

The combined directed graph and combined overlap block *NCM* of equal sizes is as follows.

$$
A =
\begin{array}{c}
\\
C_1 \\
C_2 \\
C_3 \\
C_4 \\
C_5 \\
C_6 \\
C_7 \\
C_8
\end{array}
\begin{array}{cccccccc}
C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 \\
\left(0 \right. & 2 & 0 & 0 & 0 & 0 & 1 & \left. 0 \right) \\
2 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 1 & 0 & 0 & 1 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 2 & 1 & 1 \\
0 & 0 & 0 & 1 & 2 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 1 & 0 & 0 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 2 & 0
\end{array}
$$

Now using the matrix A of the Combined overlap block NCM, we determine the hidden pattern.

Suppose the concept C_1 is in the ON state and all the nodes are in the OFF state.

Let the initial input vector be $X = (0\ 0\ 0\ 0\ 0\ 0\ 0\ 1)$, where Lack of counselors to help persons out of depression is taken as the ON state and all other nodes are in the OFF state.

The effect of X on the dynamical system A is given by:

$$XA = (0\ 0\ 0\ 0\ 0\ 0\ 2\ 0\ )$$
$$\hookrightarrow (0\ 0\ 0\ 0\ 0\ 0\ 1\ 1\ ) = X_1 \text{ (say)}$$
$$X_1\ A = (1\ 0\ 0\ 0\ 1\ 0\ 2\ 2)$$
$$\hookrightarrow (1\ 0\ 0\ 0\ 1\ 0\ 1\ 1\ ) = X_2 \text{ (say)}$$
$$X_2\ A = (1\ 2\ 0\ 0\ 1\ 2\ 4\ 3)$$
$$\hookrightarrow (1\ 1\ 0\ 0\ 1\ 1\ 1\ 1) = X_3 \text{ (say)}$$
$$X_3\ A = (3\ 2\ 0\ I\ 3\ 25\ 3)$$
$$\hookrightarrow (1\ 1\ 0\ I\ 1\ 1\ 1\ 1) = X_4$$
$$X_4\ A = (I+ 3\ I+ 2\ 0\ I\ I+3\ I^2+2\ 5\ 3)$$
$$\hookrightarrow (1\ 1\ 0\ I\ 1\ 1\ 1\ 1) = X_4$$

where $\hookrightarrow$ denotes the resultant vector after thresholding and updating, X_4 is the hidden pattern, which is the fixed point.

CONCLUSION.

While analyzing NCM, when the concept C_8, "Lack of counselors to help persons out of depression", is in the ON state, the other concepts C_1, C_2, C_5, C_6, C_7 are in the ON state, C_3 is in the OFF state, and at the same time C_4 is in indeterminate state, i.e. when there is "Lack of counselors to help persons out of depression", there will be Poverty and unmanageable living cost (Economic Crisis), Working hours - poor salary, Inability to deal with debt trap and torture from *kanduvattikarars* (usurers), Government indifferences, Stress from mental, sexual and physical torture in the working places and also there may be business failure.

Therefore "**Lack of counselors to help persons out of depression**" is the major reason for the suicide; individuals can be helped out from stress, thereby avoid suicide.

REFERENCES

1. **Kosko, B**., January, 1986, "Fuzzy Cognitive Maps", International journal of man-machine studies, pp.62-75

2. **Vasantha Kandasamy and Smarandache Florentin,** 2004, "Analysis of social aspects of migrant labourers living with HIV/AIDS using Fuzzy Theory and Neutrosophic Cognitive Maps", Xiquan, Phoenix.

3. **Vasantha Kandasamy W.B. and Victor Devadoss A.,** 2004, "Some New Fuzzy Techniques", Jour. of inst. of Math. & Comp. Sci. (Math.ser.), Vol. 17, No.2 (pp.157-160.

4. "How bonded labourer in rice mills suffer", The New Indian Express, Aug 21, 2004; and Thinathanthi, October 2004.

5. "Rich Tirupur is India's Suicide Capital", Deccan Chronicle, July 23, 2010.