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# A Study on the Influences of Ragas in Holy Mass Songs Using Neutrosophic Fuzzy Cognitive Maps (NFCMS)

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Abstract - In this paper we study to find out the vital reason for peaceful life of people from different music piece of the holy mass songs using Neutrosophic Cognitive Maps (NCMs). Due to the subjective nature of human perception, classification of the music to the peacefulness is a challenging problem. Simply assigning music class to a song segment in a deterministic way does not work well because not all people share the same feeling for a song. For each music segment, the approach determines how likely the song segment belongs to an emotion class particularly peacefulness. Results are shown to illustrate the effectiveness of the approach. In the first section we discuss about the structure of songs which have been framed in Holy mass. In section two, we study the fundamentals of Neutrosophic Cognitive Maps (NCMs). In the third Section we give the adaptation of NCM to the problem. The final section derives the conclusion based on our study.

Keywords: Music, Holy mass songs, Neutrosophic Fuzzy Cognitive Maps.

## I. INTRODUCTION

Music is important to our daily life. The influence of music becomes more profound as we enter the digital world. As the music databases grow, more efficient organization and search methods are needed. Dan Yang and Won-Sook Lee have published an article about music, how emotion is being identified from lyrics. Sanghoon Jun, Seungmin Rho, Byeong-jun Han and Eenjun Hwang have contributed the concept of a prototype music emotion recognition system and carried out various experiments to evaluate its performance using fuzzy inference based concept. In 2010, Wendy suiter did a work on "Towards Algorithmic Composition of Expression in Music Using Fuzzy Logic" which is about to find a set of elements and rules for the construction of a generalized algorithmic compositional system to produce expressive music. We employ one of the fuzzy models in our music classification system to find the peacefulness of an emotion class in association with the song under classification. To our best knowledge, this paper represents one of the first attempts that take the subjective nature of human perception into consideration for musicemotion classification from the songs of holy mass.

### 1.1. Music

Musical art is a sounding phenomenon, taking place through time, it is neither the score itself, nor its initial concept. Music is an art form whose medium is sound and silence. Its common elements are pitch (which governs melody and harmony), rhythm (and its associated concepts tempo, meter, and articulation), dynamics, and the sonic qualities of timbre and texture. The word derives from Greek*μουσική* (*mousike*; "art of the Muses"). Questions regarding musical innateness and emotional responses to music are also major areas of research in the field. Deaf people can experience music by feeling the vibrations in their body, a process that can be enhanced if the individual holds a resonant, hollow object. A well-known deaf musician is the composer Ludwig van Beethoven, who composed many famous works even after he had completely lost his hearing. But music is a bit of an evolutionary puzzle. It's hard to think of any survival value it may have brought us; a niche it filled better than any other human faculty.

### 1.2. Variety of Music:

Western
Classical
Folk
Chord Transposition in Songs
Rock music

### 1.3. The Basic Components of Music

The most basic, raw component of music is the Note. Notes move vertically and horizontally in space. Vertically, notes move up and down in various intervals of Pitch. Horizontally notes move forward in various intervals of time (Rhythm).The smallest pitch interval in all music in the western hemisphere (Americas, Europe, etc) is the half-step, or half-tone. Far-east forms of music use a quarter-tone system – which to our 'western hemisphere tuned ears 'can sound out of tune, but actually results in beautiful music with subtle nuances. Sequences of musical pitches result in melodies, Scales, modes, and arpeggios. Clusters of musical pitches result in Chords. Playing every half-tone sequentially up or down is called a Chromatic scale. Begin anywhere on your instrument, and play every note (fret) up or down, and that's it! Begin anywhere and play12 of those in a row, and you have played every note in a Chromatic Octave.

Thus, there are 12 half-steps toan octave – actually, note #13 is the same note name as note #1, just an octave higher. Continue past note 12and you are playing the same note names an octave higher in pitch. In actuality, there are only seven note names in all of music! So, how do we get twelve notes in achromatic octave? With Sharps and Flats. A sharp raises a note by a half-step. A flat lowers a note by a half step. Below is a diatonic scale beginning on C compared to a Chromatic scale starting on C:

1 2 3 4 5 6 7 8
C D E F G A B C

1 2 3 45 6 7 8
C C# D D# E F F# G G# A A# B C

Since a flat lowers a note by a half-step, C#/Db, D#/Eb, F#/Gb, G#/Ab, and A#/Bb are all the same notes.

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1.4. Impact of Music in Holy Mass Songs
The importance of music in biblical religion is shown very simply by the fact that the verb "to sing" (with related words such as "song", and so forth) is one of the most commonly used words in the Bible. It occurs 309 times in the Old Testament and thirty-six in the New. When man comes into contact with God, mere speech is not enough. From the beginning of recorded time, it has been man's instinct to raise his voice in praise and supplication to a higher power. We know from the Old Testament that Psalm tones were used in Jewish synagogues. These chants were probably influenced by the cadence of Greek poetry, and may have been the model for the chant sung in the early Christian Church.

1.5. Songs for the Celebration of the Holy Eucharist
First, we must know the four basic parts of the Mass…
Introductory Rite:Entrance Hymn
Lord have mercyGloria: Only on Sundays of ordinary time, Solemnities and Special Feast days
(a) Liturgy of the word:
1.Responsorial Psalm ( at least the response)
2.Alleluia (also called Gospel Acclamation)
(b) Liturgy of the Eucharist:
i. Song for the presentation of the gifts (Offertory Hymn)
ii. Sanctus
iii. Anamnesis (Memorial Acclamation)
iv. Great Amen
v. The Lord's prayer
vi. Lamp of God (Agnus Dei)
vii. Communion Hymn

(c) Concluding Rite:
(i) This part is optional: either sung or not
(ii) Playing of instrumental music is already enough
(iii) If sung: Thanks giving song, Marian song, or song for the saint of the day.

## II. PRELIMINARIES

This chapter introduces the concept of Neutrosophic Cognitive Maps (NCMs) defined by SmarandacheFlorentin and W.B.Vasanthakandasamy. NCMs are a generalization of Fuzzy Cognitive Maps (FCMs). Thus we have introduced the additional notion of Neutrosophy in place of Fuzzy theory. In fact one can say the inclusion of the concept of indeterminate situation with fuzzy concepts will form the neutrosophic logic. Neutrosophic logic is the only tool known to us, which deals with the notions of indeterminacy, and here we give a brief description of it.

2.1. Now we proceed on to define the concepts about NCMs.
DEFINITION 2.1.1: In the neutrosophic logic every logical variable x is described by an ordered triple x = (T, I, F) where T is the degree of truth, F is the degree of false and I the level of indeterminacy.

DEFINITION 2.1.2: 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.
Let $C_i$ and $C_j$ denote the two nodes of the NCM. The directed edge from $C_i$to $C_j$denotes the causality of $C_i$ on $C_j$ called connections. Every edge in the NCM is weighted with a number in the set {-1, 0, 1, I}. Let $e_{ij}$be the weight of the directed edge $C_iC_j$, $e_{ij} \in \{-1, 0, 1, I\}$. $e_{ij} = 0$ if $C_i$ does not have any effect on $C_j$, $e_{ij} = 1$ if increase (or decrease) in $C_i$ causes increase (or decreases) in $C_j$, $e_{ij} = -1$ if increase (or decrease) in $C_i$ causes decrease (or increase) in $C_j$ . $e_{ij}$= I if the relation or effect of $C_i$ on $C_j$ is an indeterminate.

DEFINITION 2.1.3: NCMs with edge weight from {-1, 0, 1, I} are called simple NCMs.

DEFINITION 2.1.4: Let $C_1, C_2 \ldots C_n$ be 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 $C_iC_j$, where $e_{ij} \in \{0, 1, -1, I\}$. N(E) is called the neutrosophic adjacency matrix of the NCM.

DEFINITION 2.1.5: Let $C_1, C_2 \ldots C_n$ be the nodes of the NCM. Let $A = (a_1, a_2 \ldots a_n)$ 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 2.1.6: Let $C_1, C_2 \ldots C_n$be the nodes of the FCM. Let $\overrightarrow{C_1C_2}, \overrightarrow{C_2C_3}, \ldots, \overrightarrow{C_iC_j}$ be the edges of the NCM. Then the edges form a directed cycle. An NCM is said to be cyclic if it possesses a directed cyclic. An NCM is said to be acyclic if it does not possess any directed cycle.

DEFINITION 2.1.7: An 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 2.1.8: Let $\overrightarrow{C_1C_2}, \overrightarrow{C_2C_3}, \ldots, \overrightarrow{C_{n-1}C_n}$ be cycle, when $C_i$ is switched on and if the causality flows 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 2.1.9: If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. Consider the NCM with $C_1, C_2, \ldots, C_n$ as nodes.

DEFINITION 2.1.10: If the NCM settles with a neutrosophic state vector repeating in the form

$A_1 \rightarrow A_2 \rightarrow \ldots \rightarrow A_i \rightarrow A_1$,

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

2.2 Methods of Determining the Hidden Pattern:
Let $C_1, C_2, \ldots, C_n$ be the nodes of an NCM, with feedback. Let E be the associated adjacency matrix. Let us find the hidden pattern when $C_1$ is switched on when an input is given as the vector $A_1 = (1, 0, 0, \ldots, 0)$, the data should pass through the neutrosophic matrix N(E), this is done by multiplying $A_1$ by the matrix N(E). Let $A_1N(E) = (a_1, a_2, \ldots, a_n)$ with the threshold operation that is by replacing ai by 1 if $a_i > k$ and $a_i$ by 0 if $a_i < k$

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(k – a suitable positive integer) and $a_i$ by I if $a_i$ is not a integer. We update the resulting concept; the concept $C_1$ is included in the updated vector by making the first coordinate as 1 in the resulting vector. Suppose $A_1N(E) \rightarrow A_2$ then consider $A_2N(E)$ and repeat the same procedure. This procedure is repeated till we get a limit cycle or a fixed point.

DEFINITION 2.2.1: 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 $N(E_1)$,…, $N(E_p)$. We denote the combined NCMs adjacency neutrosophic matrix by $N(E) = N(E_1) + N(E_2)+\ldots+ N(E_p)$.

## III. DESCRIPTION OF PROBLEM AND FINDING HIDDEN PATTERN USING NCM

We take the following attributes related to the peacefulness of the people and different types of music.

$C_1$ – Peacefulness from the holy mass songs

$C_2$ - Major chord songs: These are the proper notes sequence from Western music. In Carnatic music, these notes come under the raga “ShangaraBharanam”.

$C_3$ – Minor chord songs: These are the proper notes sequence from Western music. In Carnatic music, these notes come under the raga “Natabhairavi”.

$C_4$ – Major and Minor chords with accidental notes: Some improper notes will come in the song sequence while it is moving in its proper sequence. In Carnatic music, it is called as “Bashanga”.

$C_5$ – Carnatic songs: Music with its own rules, regulations and grammar. This means we should always keep its notes in a proper way.

$C_6$ – Transposition of chords from one to another for the same song: Those songs which are not moving in same chord. Chords will be changing from one to another for the same song. In Carnatic music, it is called as “RaagaMaligai”.

$C_7$ – Folk and Other types of songs: These types of songs are the combination of previous attributes from $C_2$ to $C_6$ with folk rhythms.

Now we give the directed graph as well as the neutrosophic graph of first expert in the following Figures 3.1 and 3.2:

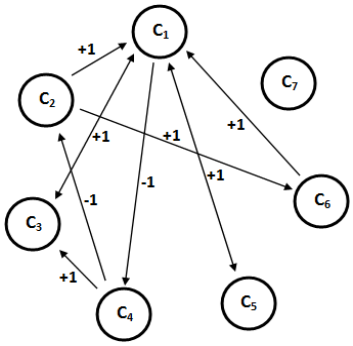


Figure 3.1

The connection matrix $E_1$ related to the graph in Figure 3.1 is given below:

$$E_1 = \begin{bmatrix} 0 & 0 & 1 & -1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

According to this expert no connection however exists between the attributes $C_1$ and $C_7$.

Now we reformulate a different format of the questionnaire where we permit the expert to give answers like the relation between certain nodes is indeterminable or not known. Now based on the expert’s opinion also about the notion of indeterminacy we obtain the following neutrosophic directed graph:

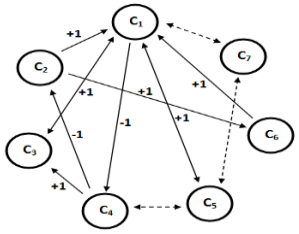


Figure 3.2

The corresponding neutrosophic adjacency matrix $N(E_1)$ related to the neutrosophic directed graph is given below:

$$N(E_1) = \begin{bmatrix} 0 & 0 & 1 & -1 & 1 & 0 & I \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 1 & 0 & I & 0 & 0 \\ 1 & 0 & 0 & I & 0 & 0 & I \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ I & 0 & 0 & 0 & I & 0 & 0 \end{bmatrix}$$

Suppose we take the initial state vector $A_1 = (1\ 0\ 0\ 0\ 0\ 0\ 0)$. That is, we take only the attribute C1 in ON state and keep the rest in OFF state. We will see the effect of $A_1$ on $E_1$.

$A_1E_1=(0\ 0\ 1\ -1\ 1\ 0\ 0)\rightarrow(1\ 0\ 1\ 0\ 1\ 0\ 0)= A_2$
$A_2E_1=(2\ 0\ 1\ -1\ 1\ 0\ 0) \rightarrow (1\ 0\ 1\ 0\ 1\ 0\ 0)= A_3 = A_2$

Thus in the resultant vector we get the nodes C1, C3 and C5 in ON state. The attributes corresponding to these nodes are peacefulness from the holy mass songs, minor chord and carnatic songs. So Minor Chord and Carnatic songs make people’s life in peacefulness from holy mass song.

Now we find the effect of $A_1 = (1\ 0\ 0\ 0\ 0\ 0\ 0)$ on $N(E_1)$.
$A_1N(E_1) =(0\ 0\ 1\ -1\ 1\ 0\ I) \rightarrow (1\ 0\ 1\ 0\ 1\ 0\ I) = A_2$
$A_2N(E_1) = (I+2\ \ 0\ 1\ \ I-1\ \ I+1\ \ 0\ 2I) \rightarrow (1\ 0\ 1\ 0\ 1\ 0\ I) = A_3 = A_2$

Thus $A_2 = (1\ 0\ 1\ 0\ 1\ 0\ I)$, according to this expert, in the resultant vector we get the nodes C1, C3 and C5 in ON state and C7 in indeterminate position. The attributes corresponding to these nodes are peacefulness from the holy mass songs, minor chord and carnatic songs. So Minor Chord and Carnatic songs make people’s life in peacefulness from holy mass song.

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This mainly gives the indeterminate factor as Folk and Other type of songs. Now we give the directed graph as well as the neutrosophic graph of another expert in the following Figures 3.3 and 3.4:

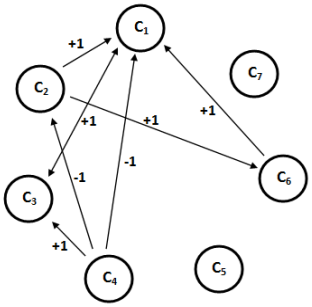


Figure3.3

The connection matrix $E_2$ related to the graph in Figure 3.3 is given below:

$$E_2 = \begin{bmatrix} 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

According to this expert, there is no connection within the attributes C1, C5 and C7. Now we reformulate a different format of the questionnaire where we permit the expert to give answers like the relation between certain nodes is indeterminable or not known. Now based on the expert's opinion also about the notion of indeterminacy we obtain the following neutrosophic directed graph:

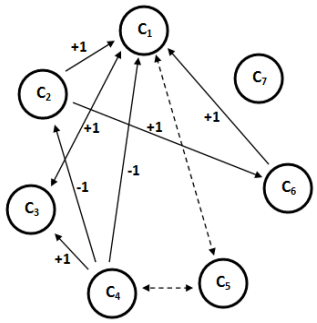


Figure 3.4

The corresponding neutrosophic adjacency matrix $N(E_2)$ related to the neutrosophic directed graph is given below:

$$N(E_2) = \begin{bmatrix} 0 & 0 & 1 & 0 & I & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & 1 & 0 & I & 0 & 0 \\ I & 0 & 0 & I & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Suppose we take the initial state vector $A_1$ = ( 1 0 0 0 0 0 0 ). That is, we take only the attribute C1 in ON state and keep the rest in OFF state. We will see the effect of $A_1$ on $E_2$.

$A_1E_2$ = ( 0 0 1 0 0 0 0 ) → ( 1 0 1 0 0 0 0 ) = $A_2$
$A_2E_2$ = ( 1 0 1 0 0 0 0 ) → ( 1 0 1 0 0 0 0 ) = $A_3$ = $A_2$

Thus the peacefulness of the people increases from the holy mass songs type of music is Minor Chord songs. Now we find the effect of $A_1$ = ( 1 0 0 0 0 0 0 ) on $N(E_2)$.

$A_1N(E_2)$ = ( 0 0 1 0 I 0 0 ) → ( 1 0 1 0 I 0 0 ) = $A_2$
$A_2N(E_2)$ = ( I +1 0 1 I I 0 0 ) → ( 1 0 1 I I 0 0 ) = $A_3$
$A_3N(E_2)$ = ( 1 -I I+1 I 2I 0 0 ) → ( 1 0 1 I I 0 0 ) = $A_4$
$A_4N(E_2)$ = ( 1 -I I+1 I 2I 0 0 ) → ( 1 0 1 I I 0 0 ) = $A_5$ = $A_4$

Thus $A_2$ = (1 0 1 I I 0 0), according to this expert, in the resultant vector we get the nodes C1 and C3 in ON state but C4 and C5 in indeterminate position. The attributes corresponding to these nodes are peacefulness from the holy mass songs and minor chord songs. So Minor Chord songs make people's life in peacefulness from holy mass song. This mainly gives the indeterminate factors as Major and Minor Chord songs with accidental nodes and Carnatic songs.

If we combine both the neutroscophic matrices according to both experts, we will get an effective result.

Now we find the effect of
$A_1$ = ( 1 0 0 0 0 0 0 ) on N(E).
$A_1N(E)$ = ( 0 0 2 -1 I+1 0 I ) → ( 1 0 1 0 1 0 I ) = $A_2$
$A_2N(E)$ = ( 2I+3 0 2 2I-1 2I+1 0 2I ) → ( 1 0 1 0 1 0 I ) = $A_3$ = $A_2$
N(E) = $N(E_1)$ +

$$N(E_2)\, N(E) = \begin{bmatrix} 0 & 0 & 2 & -1 & I+1 & 0 & I \\ 2 & 0 & 0 & 0 & 0 & 2 & 0 \\ 2 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -2 & 2 & 0 & 2I & 0 & 0 \\ I+1 & 0 & 0 & 2I & 0 & 0 & I \\ 2 & 0 & 0 & 0 & 0 & 0 & 0 \\ I & 0 & 0 & 0 & I & 0 & 0 \end{bmatrix}$$

Thus if we combine both experts opinions together, we will get Minor Chord songs and Carnatic songs make the peacefulness to the people in holy mass songs. But folk and other type of songs are in indeterminate one.

## IV. CONCLUSION

In this paper we discussed the real-world problem of promoting peacefulness from the songs of holy mass using Neutrosophic Fuzzy Cognitive Maps. Users who tested the system in a real-world environment confirmed that peacefulness from the songs of holy mass based music types are Minor chord and Carnatic songs such a way that folk and other type of songs becomes an indeterminate one. This says that those both experts cannot say anything about folk type of songs in holy mass. Our study is suggestive of applying neutrosophic cognitive map model to

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peacefulness from the holy mass songs. It can be assumed that this methodology gives an indeterminacy factor in the types of music.

## V. FUTURE DIRECTION

The objective of my work is to find a set of music components and rules of composition, which will ultimately enable to promote every type of emotion which can cure the psychological problems and disease if so desired. In order to do this we need to determine what types of music contribute to promote emotional expressions. In conclusion, it is clear that emotion particularly peacefulness is an excellent domain in which to apply fuzzy logic.

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