Type-2 Fuzzy Soft Set with Distance Measure

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Abstract *Molodtsov.D initiated the concept of soft set theory, which has become an effective mathematical tool for dealing with uncertainty. Especially fuzzy soft set theory is used to solve decision making problems. In this work, we have applied various distances and its distance measures on type-2 fuzzy soft sets and complement of type-2 fuzzy soft sets. A decision making problem is solved using this distance measure.*

Key Words: *Trapezoidal type-2 fuzzy soft sets, complement of trapezoidal type-2 fuzzy soft sets, distance measure, Hamming distance, Euclidean distance, Minkowskie's distance, Chebyshev distance.*

I. INTRODUCTION

Decision making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker. Making a decision implies that there are alternative choices to be considered, and in such a case we not only want to identify as many of these alternatives as possible but also choose the one that best fits with our goals, objectives, desires, values, and so on. Decision making should start with the identification of the decision makers in the decision, reducing the possible disagreement about problem definition, requirements, goals and criteria.

The theory of fuzzy sets was introduced by L.A.Zadeh in 1965[6]. It is progressing rapidly over the years. Soft set theory, originally proposed by Molodtsov.D [5], has become an effective mathematical tool to deal with uncertainty. P.K.Maji et al[4] first denoted the soft sets and its operation into the decision making problem.

A type-2 fuzzy set is characterized by a fuzzy membership function, which can provide us with more degrees of freedom to represent the uncertainty and vagueness of the real world. The type-2 fuzzy set can be used to represent the fuzziness of evaluation of parameters directly. The soft set and its existing extensions can not be used to deal with such parameters that involve uncertain words and linguistic terms. Hence, it is necessary to extend soft set theory using type-2 fuzzy sets.

Zhiming Zhang and Shouhua Zhang [8], [9] first introduced the concept of type-2fuzzy soft sets and trapezoidal interval type-2 fuzzy soft sets. Furthermore, some operations on trapezoidal interval type-2 fuzzy soft sets are denoted and their properties are investigated.

In this paper, we have applied distance measure with respect to various distances into trapezoidal type-2 fuzzy soft sets. A decision making problem is solved using distance measure.

This paper is organized as follows: In section 2, some basic definitions and few operations of Trapezoidal type-2 fuzzy soft sets are given. In section 3, various distances and distance measure of trapezoidal type-2 fuzzy soft set is defined. In section 4, a decision making problem is solved through this distance measure.

II. BASIC DEFINITIONS

Definition 2.1:

A soft set (P, E) is a set of all parameterized family of subsets of the non-empty universe X. For every $\varepsilon \in E$ there exists $P(\varepsilon)$ such that $P : E \to \rho(X)$, where $\rho(X)$ is a power set of X.

Definition 2.2:

A fuzzy number $A=(a,b,c,d)$ is said to be a trapezoidal fuzzy number if its membership function is given by

$$\mu_A(x)=\begin{cases}\dfrac{(x-a)}{(b-a)}, a\le x\le b\\ 1, b\le x\le c\\ \dfrac{(d-x)}{(d-c)}, \mathrm{c}\le x\le d\\ 0, otherwise.\end{cases}$$ where $a,b,c,d \in R$.

A set with trapezoidal fuzzy numbers is called trapezoidal fuzzy set[10].

Definition 2.3:

Let X be a non-empty finite set, which is referred as the universal set. A type-2 fuzzy set A is characterized by a type-2 membership function $\mu_A(x,u): X\times I \to I$ where $x \in X$, I = [0, 1] and $u \in J_x \subseteq I$ that is

$A = \{((x,u); \mu_A(x,u)/ x\in X, u \in J_x \subseteq I)\}$, where $0 \le \mu_A(x,u) \le 1$.

A can also be expressed as $A = \int_{x\in X}\int_{u\in J_x} \frac{\mu_A(x,u)}{(x,u)} = \int_{x\in U} \frac{p_x(u)/u}{x}, J_x \subseteq I$, where $p_x(u) = \mu_A(x,u)$.

The type-2 trapezoidal number is denoted by trapezoidal membership function and is denoted by $A = ([a_1,a_2,a_3,a_4],[b_1,b_2,b_3,b_4],[c_1,c_2,c_3,c_4],[d_1,d_2,d_3,d_4])$. A set with type-2 trapezoidal fuzzy numbers is called trapezoidal type-2 fuzzy set. The class of all trapezoidal type-2 fuzzy set of the universe X is denoted by $P_{TzT2}(X)$.

Definition 2.4:

A trapezoidal type-2 fuzzy soft set ($\mathscr{P}$,A) over the universal set X is a set of all parameterized family of subsets of the trapezoidal type-2 fuzzy set A. For every $\varepsilon \in A, A \subseteq E$ there exists a mapping $\mathscr{P}(\varepsilon)$ such that $\mathscr{P}: A \to P_{TzT2(A)}$ where $P_{TzT2(A)}$ denotes the set of all trapezoidal type-2 fuzzy set.

Definition 2.5:

The complement of a trapezoidal type-2 fuzzy soft set ($\mathscr{P}$, A) is denoted by ($\mathscr{P}$, A^c), and it is defined by $(\mathscr{P}(\neg\varepsilon), A) = (\mathscr{P}, A^c)$, $\mathscr{P}(\neg\varepsilon)$ is a mapping given by $\mathscr{P}(\neg\varepsilon): A^c \to P_{TzT2}(A^c)$ for all $\varepsilon \in A^c$.

Definition 2.6:

Let $(\mathscr{P}, A) = ([a_{11},a_{12},a_{13},a_{14}],[a_{21},a_{22},a_{23},a_{24}],[a_{31},a_{32},a_{33},a_{34}],[a_{41},a_{42},a_{43},a_{44}])$ and

$(\mathscr{Q}, B) = ([b_{11},b_{12},b_{13},b_{14}],[b_{21},b_{22},b_{23},b_{24}],[b_{31},b_{32},b_{33},b_{34}],[b_{41},b_{42},b_{43},b_{44}])$ be two trapezoidal type-2 fuzzy soft sets over the same universal set X. Then their addition is denoted as

$(\mathscr{R}, C) = ([c_{11},c_{12},c_{13},c_{14}],[c_{21},c_{22},c_{23},c_{24}],[c_{31},c_{32},c_{33},c_{34}],[c_{41},c_{42},c_{43},c_{44}])$ where

$c_{11} = a_{11} + b_{11}$, $c_{12} = a_{12} + b_{12}$, $c_{13} = a_{13} + b_{13}$, $c_{14} = a_{14} + b_{14}$,

$c_{21} = a_{21} + b_{21}$, $c_{22} = a_{22} + b_{22}$, $c_{23} = a_{23} + b_{23}$, $c_{24} = a_{24} + b_{24}$,

$c_{31} = a_{31} + b_{31}$, $c_{32} = a_{32} + b_{32}$, $c_{33} = a_{33} + b_{33}$, $c_{34} = a_{34} + b_{34}$,

$c_{41} = a_{41} + b_{41}$, $c_{42} = a_{42} + b_{42}$, $c_{43} = a_{43} + b_{43}$, $c_{44} = a_{44} + b_{44}$.

Definition 2.7:

Let $(\mathscr{P}, A) = ([a_{11},a_{12},a_{13},a_{14}],[a_{21},a_{22},a_{23},a_{24}],[a_{31},a_{32},a_{33},a_{34}],[a_{41},a_{42},a_{43},a_{44}])$ and

$(\mathscr{Q}, B) = ([b_{11},b_{12},b_{13},b_{14}],[b_{21},b_{22},b_{23},b_{24}],[b_{31},b_{32},b_{33},b_{34}],[b_{41},b_{42},b_{43},b_{44}])$ be two trapezoidal type-2 fuzzy soft sets over the same universal set X. Then their difference is denoted as

$(\mathscr{R}, C) = ([c_{11},c_{12},c_{13},c_{14}],[c_{21},c_{22},c_{23},c_{24}],[c_{31},c_{32},c_{33},c_{34}],[c_{41},c_{42},c_{43},c_{44}])$ where

$c_{11} = a_{11} - b_{11}$, $c_{12} = a_{12} - b_{12}$, $c_{13} = a_{13} - b_{13}$, $c_{14} = a_{14} - b_{14}$,

$c_{21} = a_{21} - b_{21}$, $c_{22} = a_{22} - b_{22}$, $c_{23} = a_{23} - b_{23}$, $c_{24} = a_{24} - b_{24}$,

$c_{31} = a_{31} - b_{31}$, $c_{32} = a_{32} - b_{32}$, $c_{33} = a_{33} - b_{33}$, $c_{34} = a_{34} - b_{34}$,

$c_{41} = a_{41} - b_{41}$, $c_{42} = a_{42} - b_{42}$, $c_{43} = a_{43} - b_{43}$, $c_{44} = a_{44} - b_{44}$.

Definition 2.8:

The ranking function $\mathbf{R}$ for a type-2 fuzzy number $A=([a_1,a_2,a_3,a_4],[b_1,b_2,b_3,b_4],[c_1,c_2,c_3,c_4],[d_1,d_2,d_3,d_4])$ is given by $\mathbf{R}(A)=\frac{1}{36}(a_1+2a_2+2a_3+a_4+2b_1+4b_2+4b_3+2b_4+2c_1+4c_2+4c_3+2c_4+d_1+2d_2+2d_3+d_4)$.

III.DISTANCE MEASURE BASED ON VARIOUS DISTANCES FOR TYPE-2 FUZZY SOFT SET

3.1 Distances for Type-2 Fuzzy Soft Set

Let ($\mathscr{P}$,A) and ($\mathscr{Q}$, B) be two trapezoidal type-2 fuzzy soft sets over the same universal set X. Then various distance between the ε_j -th parameter of $\left(\mathscr{P},A\left(\varepsilon_{ij}\right)\right)$ and $\left(\mathscr{Q},B\left(\varepsilon_{ij}\right)\right)$ are denoted as follows:

i. Hamming distance:

$$d_{H_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=\frac{1}{m}\sum_{i=1}^{n}\left|\left(\mathscr{P},A\left(\varepsilon_{ij}\right)\right)-\left(\mathscr{Q},B\left(\varepsilon_{ij}\right)\right)\right|.$$

ii. Normalized hamming distance :

$$d_{nH_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=\frac{1}{nm}\sum_{i=1}^{n}\left|\left(\mathscr{P},A\left(\varepsilon_{ij}\right)\right)-\left(\mathscr{Q},B\left(\varepsilon_{ij}\right)\right)\right|$$

iii. Euclidean distance :

$$d_{E_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=\frac{1}{m}\sum_{i=1}^{n}\left[\left|\left(\mathscr{P},A\left(\varepsilon_{ij}\right)\right)-\left(\mathscr{Q},B\left(\varepsilon_{ij}\right)\right)\right|^2\right]^{1/2}$$

iv. Normalized Euclidean distance :

$$d_{nE_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=\frac{1}{nm}\sum_{i=1}^{n}\left[\left|\left(\mathscr{P},A\left(\varepsilon_{ij}\right)\right)-\left(\mathscr{Q},B\left(\varepsilon_{ij}\right)\right)\right|^2\right]^{1/2}$$

v. Minkowskie's distance :

$$d_{M_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=\frac{1}{m}\sum_{i=1}^{n}\left[\left|\left(\mathscr{P},A\left(\varepsilon_{ij}\right)\right)-\left(\mathscr{Q},B\left(\varepsilon_{ij}\right)\right)\right|^p\right]^{1/p}$$

vi. Minkowskie's distance :

$$d_{nM_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=\frac{1}{nm}\sum_{i=1}^{n}\left[\left|\left(\mathscr{P},A\left(\varepsilon_{ij}\right)\right)-\left(\mathscr{Q},B\left(\varepsilon_{ij}\right)\right)\right|^p\right]^{1/p}$$

vii. Chebyshev distance:

$$d_{C_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=\sup_{x\in X}\left|\left(\mathscr{P},A\left(\varepsilon_{ij}\right)\right)-\left(\mathscr{Q},B\left(\varepsilon_{ij}\right)\right)\right|$$

3.2 Distance Measure

The Distance measure based on the above distances (i – vii) is denoted by M_4 and is defined by $M_4\left((\mathscr{P},A),(\mathscr{Q},B)\right)=\max_j\left\{M_{4_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)\right\}$ where

i. $M_{4_j}^{H}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=1-d_{H_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)$

ii. $M_{4_j}^{nH}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=1-d_{nH_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)$

iii. $M_{4_j}^{E}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=1-d_{E_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)$

iv. $M_{4_j}^{nE}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=1-d_{nE_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)$

v. $M_{4_j}^{M}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=1-d_{M_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)$

vi. $M_{4_j}^{nM}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=1-d_{nM_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)$

vii. $M_{4_j}^{C}\left((\mathscr{P},A),(\mathscr{Q},B)\right)=1-d_{C_j}\left((\mathscr{P},A),(\mathscr{Q},B)\right)$

IV. NUMERICAL EXAMPLE

Suppose that a car company is decided to select the most appropriate robot for its manufacturing process. The company has to choose two sets of three robots r_1, r_2, r_3 under consideration. They consider four characteristics of robots as parameters, as follows:

- load capacity (C_1)
- repeatability (C_2)
- Speed (C_3) and
- memory capacity (C_4)

From the above informations the company has to choose robots with best characteristic. Here we are going to choose a best parameter with these two sets of robots. Now all the available information on robots under consideration can be formulated as trapezoidal type-2 fuzzy soft set. These two sets are tabulated as follows:

TABLE 4.1
TABULAR REPRESENTATION OF THE TYPE-2 FUZZY SOFT SET ($\mathscr{P}$,A)

($\mathscr{P}$, A)	ε_1	ε_2	ε_3	ε_4
r_1	([0.5,0.6,0.7,0.8], [0.2,0.3,0.4,0.5], [0.3,0.5,0.7,0.9], [0.1,0.2,0.3,0.4])	([0.4,0.5,0.6,0.7], [0.2,0.4,0.6,0.8], [0.3,0.5,0.7,0.9], [0.1,0.3,0.5,0.7])	([0.1,0.3,0.5,0.7], [0.2,0.4,0.6,0.8], [0.5,0.6,0.7,0.8], [0.0,0.3,0.6,0.9])	([0.2,0.4,0.6,0.8], [0.2,0.3,0.4,0.5], [0.5,0.6,0.7,0.8], [0.6,0.7,0.8,0.9])
r_2	([0.1,0.2,0.3,0.4], [0.0,0.2,0.4,0.6], [0.2,0.4,0.6,0.8], [0.5,0.6,0.7,0.8])	([0.3,0.5,0.7,0.9], [0.1,0.2,0.3,0.4], [0.0,0.2,0.4,0.6], [0.6,0.7,0.8,0.9])	([0.0,0.3,0.6,0.9], [0.1,0.2,0.3,0.4], [0.5,0.6,0.7,0.8], [0.4,0.6,0.8,1.0])	([0.0,0.1,0.2,0.3], [0.2,0.3,0.4,0.5], [0.4,0.5,0.6,0.7], [0.6,0.7,0.8,0.9])
r_3	([0.1,0.3,0.5,0.7], [0.3,0.5,0.7,0.9], [0.5,0.6,0.7,0.8], [0.2,0.3,0.4,0.5])	([0.0,0.1,0.2,0.3], [0.6,0.7,0.8,0.9], [0.2,0.3,0.4,0.5], [0.4,0.5,0.6,0.7])	([0.2,0.3,0.4,0.5], [0.3,0.5,0.7,0.9], [0.5,0.6,0.7,0.8], [0.0,0.1,0.2,0.3])	([0.2,0.3,0.4,0.5], [0.4,0.5,0.6,0.7], [0.7,0.8,0.9,1.0], [0.1,0.3,0.5,0.7])

TABLE 4.2
TABULAR REPRESENTATION OF THE COMPLEMENT OF TRAPEZOIDAL TYPE-2 FUZZY SOFT SET ($\mathscr{P}$, A^C)

($\mathscr{P}$, A^c)	ε_1	ε_2	ε_3	ε_4
r_1	([0.5,0.4,0.3,0.2], [0.8,0.7,0.6,0.5], [0.7,0.5,0.3,0.1], [0.9,0.8,0.7,0.6])	([0.6,0.5,0.4,0.3], [0.8,0.6,0.4,0.2], [0.7,0.5,0.3,0.1], [0.9,0.7,0.5,0.3])	([0.9,0.7,0.5,0.3], [0.8,0.6,0.4,0.2], [0.5,0.4,0.3,0.2], [1.0,0.7,0.4,0.1])	([0.8,0.6,0.4,0.2], [0.8,0.7,0.6,0.5], [0.5,0.4,0.3,0.2], [0.4,0.3,0.2,0.1])
r_2	([0.9,0.8,0.7,0.6], [1.0,0.8,0.6,0.4], [0.8,0.6,0.4,0.2], [0.5,0.4,0.3,0.2])	([0.7,0.5,0.3,0.1], [0.9,0.8,0.7,0.6], [1.0,0.8,0.6,0.4], [0.4,0.3,0.2,0.1])	([1.0,0.7,0.4,0.1], [0.9,0.8,0.7,0.6], [0.5,0.4,0.3,0.2], [0.6,0.4,0.2,0.0])	([1.0,0.9,0.8,0.7], [0.8,0.7,0.6,0.5], [0.6,0.5,0.4,0.3], [0.4,0.3,0.2,0.1])
r_3	([0.9,0.7,0.5,0.3], [0.7,0.5,0.3,0.1], [0.5,0.4,0.3,0.2], [0.8,0.7,0.6,0.5])	([1.0,0.9,0.8,0.7], [0.4,0.3,0.2,0.1], [0.8,0.7,0.6,0.5], [0.6,0.5,0.4,0.3])	([0.8,0.7,0.6,0.5], [0.7,0.5,0.3,0.1], [0.5,0.4,0.3,0.2], [1.0,0.9,0.8,0.7])	([0.8,0.7,0.6,0.5], [0.6,0.5,0.4,0.3], [0.3,0.2,0.1,0.0], [0.9,0.7,0.5,0.3])

TABLE 4.3
TABULAR REPRESENTATION OF THE TYPE-2 FUZZY SOFT SET ($\mathcal{Q}$,B)

($\mathcal{Q}$, B)	ε_1	ε_2	ε_3	ε_4
r_1	([0.6,0.7,0.8,0.9], [0.0,0.3,0.6,0.9], [0.2,0.4,0.6,0.8], [0.1,0.3,0.5,0.7])	([0.2,0.3,0.4,0.5], [0.5,0.6,0.7,0.8], [0.1,0.4,0.7,1.0], [0.4,0.6,0.8,1.0])	([0.3,0.5,0.7,0.9], [0.1,0.4,0.7,1.0], [0.2,0.4,0.6,0.8], [0.7,0.8,0.9,1.0])	([0.1,0.4,0.7,1.0], [0.2,0.4,0.6,0.8], [0.3,0.5,0.7,0.9], [0.7,0.8,0.9,1.0])
r_2	([0.3,0.5,0.7,0.9], [0.2,0.4,0.6,0.8], [0.1,0.2,0.3,0.4], [0.5,0.6,0.7,0.8])	([0.3,0.4,0.5,0.6], [0.4,0.6,0.8,1.0], [0.2,0.3,0.4,0.5], [0.5,0.6,0.7,0.8])	([0.2,0.3,0.4,0.5], [0.4,0.6,0.8,1.0], [0.5,0.6,0.7,0.8], [0.2,0.4,0.6,0.8])	([0.2,0.3,0.4,0.5], [0.6,0.7,0.8,0.9], [0.3,0.4,0.5,0.6], [0.2,0.4,0.6,0.8])
r_3	([0.1,0.3,0.5,0.7], [0.2,0.4,0.6,0.8], [0.5,0.6,0.7,0.8], [0.4,0.6,0.8,1.0])	([0.1,0.4,0.7,1.0], [0.3,0.4,0.5,0.6], [0.6,0.7,0.8,0.9], [0.2,0.3,0.4,0.5])	([0.2,0.3,0.4,0.5], [0.1,0.3,0.5,0.7], [0.3,0.4,0.5,0.6], [0.6,0.7,0.8,0.9])	([0.2,0.3,0.4,0.5], [0.3,0.5,0.7,0.9], [0.3,0.4,0.6,0.8], [0.6,0.7,0.8,0.9])

TABLE 4.4
TABULAR REPRESENTATION OF THE COMPLEMENT OF TRAPEZOIDAL TYPE-2 FUZZY SOFT SET ($\mathcal{Q}$, B^C)

($\mathcal{Q}$, B^c)	ε_1	ε_2	ε_3	ε_4
r_1	([0.4,0.3,0.2,0.1], [1.0,0.7,0.4,0.1], [0.8,0.6,0.4,0.2], [0.9,0.7,0.5,0.3])	([0.8,0.7,0.6,0.5], [0.5,0.4,0.3,0.2], [0.9,0.6,0.3,0.0], [0.6,0.4,0.2,0.0])	([0.7,0.5,0.3,0.1], [0.9,0.6,0.3,0.0], [0.8,0.6,0.4,0.2], [0.3,0.2,0.1,0.0])	([0.9,0.6,0.3,0.0], [0.8,0.6,0.4,0.2], [0.7,0.5,0.3,0.1], [0.3,0.2,0.1,0.0])
r_2	([0.7,0.5,0.3,0.1], [0.8,0.6,0.4,0.2], [0.9,0.8,0.7,0.6], [0.5,0.4,0.3,0.2])	([0.7,0.6,0.5,0.4], [0.6,0.4,0.2,0.0], [0.8,0.7,0.6,0.5], [0.5,0.4,0.3,0.2])	([0.2,0.3,0.4,0.5], [0.4,0.6,0.8,1.0], [0.5,0.6,0.7,0.8], [0.2,0.4,0.6,0.8])	([0.8,0.7,0.6,0.5], [0.4,0.3,0.2,0.1], [0.7,0.6,0.5,0.4], [0.8,0.6,0.4,0.2])
r_3	([0.9,0.7,0.5,0.3], [0.8,0.6,0.4,0.2], [0.5,0.4,0.3,0.2], [0.6,0.4,0.2,0.0])	([0.9,0.6,0.3,0.0], [0.7,0.6,0.5,0.4], [0.4,0.3,0.2,0.1], [0.8,0.7,0.6,0.5])	([0.8,0.7,0.6,0.5], [0.9,0.7,0.5,0.3], [0.7,0.6,0.5,0.4], [0.4,0.3,0.2,0.1])	([0.8,0.7,0.6,0.5], [0.7,0.5,0.3,0.1], [0.7,0.6,0.4,0.2], [0.4,0.3,0.2,0.1])

Using the above mentioned definitions, we find the distance measure between trapezoidal type-2 fuzzy soft sets. The calculated values are tabulated as follows:

TABLE 4.5
CALCULATED VALUES OF VARIOUS DISTANCES

Parameters	ε_1	ε_2	ε_3	ε_4	**Selected parameter**
$d_H\left((\mathscr{P},A),(\mathcal{Q},B)\right)$	0.1435	0.2380	0.2074	0.1843	ε_1
$d_{nH}\left((\mathscr{P},A),(\mathcal{Q},B)\right)$	0.0359	0.0595	0.0519	0.0461	ε_1
$d_E\left((\mathscr{P},A),(\mathcal{Q},B)\right)$	0.1107	0.1634	0.1583	0.1391	ε_1
$d_{nE}\left((\mathscr{P},A),(\mathcal{Q},B)\right)$	0.0277	0.0409	0.0396	0.0348	ε_1

$d_C((\mathscr{P},A),(\mathscr{Q},B))$	0.2778	0.4028	0.3696	0.3417	ε_1
$d_H((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.1435	0.2380	0.2074	0.1843	ε_1
$d_{nH}((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.0359	0.0595	0.0519	0.0461	ε_1
$d_E((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.1107	0.1634	0.1583	0.1391	ε_1
$d_{nE}((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.0277	0.0409	0.0396	0.0348	ε_1
$d_C((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.2778	0.4028	0.3696	0.3417	ε_1

From the above table, the calculated values of various distance of type-2 fuzzy soft sets are same that of its complement.

TABLE 4.6
CALCULATED VALUES OF VARIOUS DISTANCE MEASURE

Parameters	ε_1	ε_2	ε_3	ε_4	**Selected parameter**
$M_4^H((\mathscr{P},A),(\mathscr{Q},B))$	0.1435	0.2380	0.2074	0.1843	ε_1
$M_4^{nH}((\mathscr{P},A),(\mathscr{Q},B))$	0.0359	0.0595	0.0519	0.0461	ε_1
$M_4^E((\mathscr{P},A),(\mathscr{Q},B))$	0.1107	0.1634	0.1583	0.1391	ε_1
$M_4^{nE}((\mathscr{P},A),(\mathscr{Q},B))$	0.0277	0.0409	0.0396	0.0348	ε_1
$M_4^C((\mathscr{P},A),(\mathscr{Q},B))$	0.2778	0.4028	0.3696	0.3417	ε_1
$M_4^H((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.1435	0.2380	0.2074	0.1843	ε_1
$M_4^{nH}((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.0359	0.0595	0.0519	0.0461	ε_1
$M_4^E((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.1107	0.1634	0.1583	0.1391	ε_1
$M_4^{nE}((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.0277	0.0409	0.0396	0.0348	ε_1
$M_4^C((\mathscr{P},A^c),(\mathscr{Q},B^c))$	0.2778	0.4028	0.3696	0.3417	ε_1

From the above table, the calculated values of distance measure with respect to various distances of type-2 fuzzy soft sets are same that of its complement.

The parameter ε_1 is having maximum measure value among all the four parameters. So that, the robots with load capacity (ε_1) is selected from the set of robots.

V. CONCLUSION

In this paper, we have proved that various distances and its measure have similar values for the parameters of trapezoidal type-2 fuzzy soft sets. A decision making problem is solved to illustrate this procedure. In future work, other types of distance measures can also be used to find the solution of any decision making problem.

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