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Near Plithogenic Hypersoft Sets

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Abstract. The article focuses on combining the near set theory with plithogenic hypersoft sets. In addition, near plithogenic hypersoft sets on different environments have been discussed.

Keywords Near set, Nearness approximation spaces, Near Hypersoft set, Near Plithogenic Hypersoft set.

1. INTRODUCTION

James.F.Peters[1] introduces the near sets as a generalization of rough sets, in which, objects with matching descriptions are considered near each other. A rough set deals with nonempty boundaries. By contrast, a near set deals with the features of the objects. Peters introduced the nearness approximation space to introduce a nearness relation to the existing approximation space model.

The notion of soft sets was first commenced by Molodtsov [2] to deal with uncertainty.

The concept of hypersoft set was initiated by Florentin Smarandache[3]. He defines hypersoft set as a multi-argumented function, where one can have multiple parameters and so it can be used in several applications.

Florentin Smarandache[3,4] introduces the plithogenic set as a generalization of crisp, fuzzy, intuitionistic fuzzy and neutrosophic sets. A plithogenic set is characterized by one or more parameters and each parameter may have several values.

2. PRELIMINARIES

Definition 2.1[1] Let U be the Global (Universal) set of objects, A, B⊆U and Þ be the set of all functions representing object features (probe functions), D⊆ Þ. Sets A and B are said to be near if a ϵA, b ϵB and α_i ϵ D, $1\leq\alpha\leq n$ and $a\sim_{\{\alpha i\}} b$.

Notations	Definition
$\sim_{Dq}$	$\sim_{Dq} = \{(a,b)/ \alpha(a)= \alpha(b), \text{ for all } \alpha \in D_q\}$ (similarity relation)
$[a]_{Dq}$	$[a]_{Dq} = \{b \in U/a\sim_{Dq}b\}$ (equivalence class)
$U/\sim_{Dq}$	$U/\sim_{Dq}= \{[a]_{Dq} /a \in U\}$ (quotient set)
ρ_{Dq}	$\rho_{Dq}= U/\sim_{Dq}$ (partitions)
$\underline{\Gamma q(D)}(A)$	$\bigcup_{a:[a]Dq\subseteq A} [a]Dq$ (lower approximation)
$\overline{\Gamma q(D)}(A)$	$\bigcup_{a:[a]Dq\cap A\neq\emptyset} [a]Dq$ (upper approximation)
$B_{\Gamma q(D)}(A)$	$\overline{\Gamma q(D)}(A) - \underline{\Gamma q(D)}(A)$ (boundary)

Table 1[1]

Definition 2.2 [1] A nearness approximation space is a collection NAS= $(U, Þ, \sim_{Dq}, \Gamma_q, \zeta_{\Gamma q})$ where U represents the global set of objects, Þ denotes the probe functions, $\sim_{Dq}$ is the similarity relation on $D_q \subseteq D \subseteq$ Þ, Γ_q denotes the pile of partitions (collection of neighborhoods) and $\zeta_{\Gamma q}$ denotes the neighborhood overlap function.

The lower and upper near approximations of A with respect to NAS is given by,

$$\underline{\Gamma q(D)}(A) = \cup_{a:[a]Dq\subseteq A} [a]Dq \text{ and}$$

$$\overline{\Gamma q(D)}(A) = \cup_{a:[a]Dq\cap A\neq\emptyset}[a]Dq \text{ respectively}$$

The boundary of A with respect to NAS is given by, $B_{\Gamma q(D)}(A)= \overline{\Gamma q(D)}(A) - \underline{\Gamma q(D)}(A)$

If $B_{\Gamma q(D)}(A)\geq 0$, then A is a near set.[By Neighbourhoods Approximation Boundary Theorem].

Definition 2.3 [3] Let U be the global set of objects, P(U) the power set of U. Let $n_1,n_2,\ldots n_m$, $m\geq 1$ be the parameters whose values belong to the sets $N_1,N_2,\ldots N_m$ respectively and $N_i \cap N_j = \emptyset$, $i \neq j$, $i,j \in \{1,2,3,\ldots n\}$. Then the set $(F, N_1xN_2x\ldots N_m)$ where $F: N_1xN_2x\ldots N_m \longrightarrow P(U)$ is the hypersoft set (H_s) over U.

Definition 2.4 [4] Let U be the global set of objects, $A\subseteq U$ and let $n_1,n_2,\ldots n_m$, $m\geq 1$ be the parameters, R be the range of values of the parameter and among the range of parameter values, there is a dominant attribute value d which is the most essential value that one is interested in. Also, let d_a be the degree of appurtenance of each parameter value to the set A and d_c is the degree of contradiction between values of the parameter.

Then the tuple (A,n_m,R,d_a, d_c) is the plithogenic set.

Definition 2.5 [4,5] Let U be the global set of objects, A⊆U and P(U) the power set of U. Let $n_1,n_2,\ldots n_m$, $m\geq1$ be the parameters whose values belong to the sets $N_1,N_2,\ldots N_m$ respectively and $N_i \cap N_j = \emptyset$, $i \neq j$, $i,j \in \{1,2,3,\ldots n\}$, R be the range of values of the parameter, d_a be the degree of appurtenance of each parameter value to the set A and d_c be the degree of contradiction between values of the parameter.. Then the set (F_p, $N_1xN_2x\ldots N_m$) where F_p: $N_1xN_2x\ldots N_m \longrightarrow P(U)$ is the plithogenic hypersoft set (PH_s) over U.

3. NEAR HYPERSOFT SET

Definition 3.1 Let U be the global set of objects, A⊆U, **Ω** be a hypersoft set over U and NAS= (U, Þ, $\sim_{Dq}$, Γ_q, $\zeta_{\Gamma q}$) be the nearness approximation space. The lower and upper near approximations of **Ω** with respect to NAS is given by,

$\underline{\Gamma q(D)}(\Omega) = \bigcup_{a:[a]Dq\subseteq\Omega} [a]Dq$ and $\overline{\Gamma q(D)}(\Omega) = \bigcup_{a:[a]Dq\cap\Omega\neq\emptyset} [a]Dq$ respectively

The boundary of Ω with respect to NAS is given by, $B_{\Gamma q(D)}(\Omega) = \overline{\Gamma q(D)}(\Omega) - \underline{\Gamma q(D)}(\Omega)$

If $B_{\Gamma q(D)}(\Omega) \geq 0$, then **Ω** is a near hypersoft set.

Example 3.2

Let U={I_1,I_2,I_3,I_4,I_5} be the global set of iron boxes and A={I_1,I_2,I_3,I_5} ⊆U. Let Þ ={ α_1, α_2, α_3, α_4, α_5} be the probe functions representing features of object. Let n_1= type, n_2= power consumption, n_3= sole plate type be the parameters whose values belong to the sets $N_1(\alpha_1, \alpha_2)$= {dry iron, steam iron}, $N_2(\alpha_3, \alpha_4)$={<1000 W, >1000 W}, $N_3(\alpha_5)$={non-stick}

	I_1	I_2	I_3	I_4	I_5
α_1	1	0	2	1	3
α_2	0	2	0	0	1
α_3	1	0	1	3	2
α_4	0	1	2	1	3
α_5	3	1	3	0	1

Let **Ω** ={((α_1, α_3, α_5){I_1,I_3,I_5}), ((α_2, α_3, α_5){I_1,I_2})}

$[I_1]_{\alpha 1}$ = {b ϵ U/ $\alpha_1(b) = \alpha_1(I_1) = 1$}

$= \{I_1, I_4\}$

$[I_2]_{\alpha 1} = \{b \in U / \alpha_1(b) = \alpha_1(I_2) = 0\}$

$= \{I_2\}$

$[I_3]_{\alpha 1} = \{b \in U / \alpha_1(b) = \alpha_1(I_3) = 2\}$

$= \{I_3\}$

$[I_5]_{\alpha 1} = \{b \in U / \alpha_1(b) = \alpha_1(I_5) = 3\}$

$= \{I_5\}$

Similarly,

$[I_1]_{\alpha 2} = \{I_1, I_3, I_4\}$

$[I_2]_{\alpha 2} = \{I_2\}$

$[I_5]_{\alpha 2} = \{I_5\}$

$[I_1]_{\alpha 3} = \{I_1, I_3\}$

$[I_2]_{\alpha 3} = \{I_2\}$

$[I_4]_{\alpha 3} = \{I_4\}$

$[I_5]_{\alpha 3} = \{I_5\}$

$[I_1]_{\alpha 4} = \{I_1\}$

$[I_2]_{\alpha 4} = \{I_2, I_4\}$

$[I_3]_{\alpha 4} = \{I_3\}$

$[I_5]_{\alpha 4} = \{I_5\}$

$[I_1]_{\alpha 5} = \{I_1, I_3\}$

$[I_2]_{\alpha 5} = \{I_2, I_5\}$

$[I_4]_{\alpha 5} = \{I_4\}$

$\underline{\Gamma q(D)}(\Omega) = [I_3]_{\alpha 1} \cup [I_5]_{\alpha 1} \cup [I_2]_{\alpha 2} \cup [I_1]_{\alpha 3} \cup [I_2]_{\alpha 3} \cup [I_5]_{\alpha 3} \cup [I_1]_{\alpha 5}$

$= \{I_1, I_2, I_3, I_5\}$

$\overline{\Gamma q(D)}(\Omega) = [I_1]_{\alpha 1} \cup [I_3]_{\alpha 1} \cup [I_5]_{\alpha 1} \cup [I_1]_{\alpha 2} \cup [I_2]_{\alpha 2} \cup [I_1]_{\alpha 3} \cup [I_2]_{\alpha 3} \cup [I_1]_{\alpha 5} \cup [I_2]_{\alpha 5}$

$= \{I_1, I_2, I_3, I_4, I_5\}$

$B_{\Gamma q(D)}(\Omega) = \{I_4\} \geq 0.$

Therefore Ω is a near hypersoft set.

4. NEAR PLITHOGENIC HYPERSOFT SET

Definition 4.1 Let U be the global set of objects, A⊆U, **Ω** be a plithogenic hypersoft set over U and NAS= (U, Þ, $\sim_{Dq}$, Γ_q, $\zeta_{\Gamma q}$) be the nearness approximation space. The lower and upper near approximations of **Ω** with respect to NAS is given by,

$$\underline{\Gamma q(D)}(\Omega) = \cup_{a:[a]Dq\subseteq\Omega}\,[a]Dq \text{ and}$$

$$\overline{\Gamma q(D)}(\Omega) = \cup_{a:[a]Dq\cap\Omega\neq\emptyset}[a]Dq$$

respectively. The boundary of Ω with respect to NAS is given by, $B_{\Gamma q(D)}(\Omega) = \overline{\Gamma q(D)}(\Omega) - \underline{\Gamma q(D)}(\Omega)$

If $B_{\Gamma q(D)}(\Omega)\geq 0$, then Ω is a near plithogenic hypersoft set.

4.1 Near Plithogenic Hypersoft sets in different environments

- **Near Plithogenic Hypersoft sets in Crisp environment**

The degree of appurtenance of each parameter of the near plithogenic hypersoft set is a crisp set.

Example 4.1.1 Let U={a_1, a_2,a_3,a_4,a_5} be the global set of shirts, Þ ={ α_1, α_2, α_3,…, α_{10}} be the probe functions representing features of the object. Let n_1= color, n_2= sleeve, n_3= size, n_4 =design be the parameters whose values belong to the sets $N_1(\alpha_1, \alpha_2)$= {light, dark}, $N_2(\alpha_3, \alpha_4)$={full, half}, $N_3(\alpha_5, \alpha_6, \alpha_7)$={small, medium, large}and $N_4(\alpha_8, \alpha_9, \alpha_{10})$={plain, checked, floral}

A={a_3,a_4}⊆U.

Consider Ω (dark, half, medium, plain) = {a_3(1,0,1,1), a_4(1,1,1,0)}

- **Near Plithogenic Hypersoft sets in Fuzzy environment**

The degree of appurtenance of each parameter of the near plithogenic hypersoft set is a fuzzy set.

Consider Example 4.1.1,

Near plithogenic hypersoft sets in fuzzy environment can be written as

Ω (dark, half, medium, plain) = {a_3(0,0.3,0.1,0.8), a_4(0.4,0.1,0.1,0.5)}

- **Near Plithogenic Hypersoft sets in Intuitionistic fuzzy environment**

The degree of appurtenance of each parameter of the near plithogenic hypersoft set is an intuitionistic fuzzy set.

Consider Example 4.1.1,

Near plithogenic hypersoft sets in intuitionistic fuzzy environment can be written as

Ω (dark, half, medium, plain) = {a_3((0,0.3) (0.7,0.2) (0.3,0.4) (0.7,0.1)), a_4((0.3,0.8) (0.6,0.8) (0.4,0.7) (0.8,0.2))}

- **Near Plithogenic Hypersoft sets in Neutrosophic environment**

The degree of appurtenance of each parameter of the near plithogenic hypersoft set is a neutrosophic set.

Consider Example 4.1.1

	a_1	a_2	a_3	a_4	a_5
N_1 α_1(light)	(.3,.2,.1)	(.4,.1,.8)	(.8,.2,.4)	(.3,.2,.1)	(.6,.3,.1)
α_2(dark)	(.7,.8,.9)	(.3,.2,.1)	(.6,.3,.1)	(.7,.8,.9)	(.3,.2,.1)
N_2 α_3(full)	(.8,.2,.4)	(.7,.8,.9)	(.3,.2,.1)	(.3,.2,.1)	(.4,.1,.8)
α_4(half)	(.4,.1,.8)	(.6,.3,.1)	(.7,.8,.9)	(.8,.2,.4)	(.3,.2,.1)
N_3 α_5(small)	(.3,.2,.1)	(.8,.2,.4)	(.8,.2,.4)	(.4,.1,.8)	(.7,.8,.9)
α_6(medium)	(.7,.8,.9)	(.3,.2,.1)	(.7,.8,.9)	(.3,.2,.1)	(.6,.3,.1)
α_7(large)	(.6,.3,.1)	(.7,.8,.9)	(.8,.2,.4)	(.7,.8,.9)	(.8,.2,.4)
N_4 α_8(plain)	(.7,.8,.9)	(.8,.2,.4)	(.7,.8,.9)	(.6,.3,.1)	(.7,.8,.9)
α_9(checked)	(.3,.2,.1)	(.8,.2,.4)	(.3,.2,.1)	(.3,.2,.1)	(.7,.8,.9)
α_{10}(floral)	(.4,.1,.8)	(.6,.3,.1)	(.7,.8,.9)	(.6,.3,.1)	(.7,.8,.9)

Table 5 Neutrosophic values for degree of appurtenance of plithogenic hypersoft set

Let A={a_1,a_2,a_4}.

From the table,

Ω ={((α_1, α_3, α_5, α_8){a_1,a_4}), ((α_2, α_4, α_6, α_9){a_2})}

$[a_1]_{\alpha 1}$ = {b є U/ α_1(b)= α_1(a_1) = (.3,.2,.1)}

= {a_1, a_4}

Similarly,

$[a_2]_{\alpha 1}$ = {a_2}

$[a_3]_{\alpha 1}$ = {a_3}

$[a_5]_{\alpha 1}$ = {a_5}

$[a_1]_{\alpha 2}$ = {a_1,a_4}

$[a_2]_{\alpha 2}$ = {a_2,a_5}

$[a_3]_{\alpha 2}$ = {a_3}

Likewise computing all the equivalence classes, we get,

$\underline{\Gamma q(D)}(\Omega)$ ={a_1,a_2,a_4}

$\overline{\Gamma q(D)}(\Omega)$ ={a_1,a_2,a_3,a_4,a_5}

$B_{\Gamma q(D)}(\Omega) = \{a_3, a_5\} \geq 0$.

Therefore Ω (dark, half, medium, plain) is a near plithogenic hypersoft set.

CONCLUSION

Thus, the near set theory is combined with the plithogenic hypersoft sets and near plithogenic hypersoft set in crisp, fuzzy, intuitionistic fuzzy and neutrosophic environments are discussed. Various properties such as union, intersection, interior , closure and the theoretical properties are to be defined in future.

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