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Some Properties of Induced Intuitionistic Fuzzy Sets on Complements

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ABSTRACT: *In this paper we have proved some complement properties on four different types of induced intuitionistic fuzzy sets* $A^{\circ}(B), A^{*}(B), A_{\circ}(B)$ *and* $A_{*}(B)$ *corresponding to the intuitionistic fuzzy sets* A *and* B*, of a set* E*, and their complements.*

KEYWORDS: *Degree of membership, degree of non-membership, induced intuitionistic fuzzy set, compliments of intuitionistic fuzzy sets.*
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I. INTRODUCTION

The notion of Intuitionistic fuzzy set (IFS) was introduced by K. Atanassov in [1]. Various properties on intuitionistic fuzzy sets were discussed by many authors in [2- 5]. The concept of four different types of induced intuitionistic fuzzy sets was introduced in [6] and discussed various properties on it. Some relations between induced intuitionistic fuzzy sets and second order induced intuitionistic fuzzy sets were established in [7,8]. Here, in this paper, we have proved some complement properties on induced intuitionistic fuzzy sets.

The section 2 deals with the definitions and notations of induced intuitionistic fuzzy sets and intuitionistic fuzzy set of a set.

In section 3, we have proved some properties regarding complements of induced intuitionistic fuzzy sets corresponding to intuionistic fuzzy sets and their complements .

II. PRELIMINARIES

This section contains some basic definitions and notations which are used through-out the paper.

Definition 2.1 [1-3]: Let E be any non-empty set. An intuitionistic fuzzy set A of E is an object of the form $A = \{ (x, \mu_A(x), \nu_A(x)) : x \in E\}$, where the functions $\mu_A : E \to [0,1]$ and $\nu_A : E \to [0,1]$ denotes the degree of membership and the non – membership functions respectively and for every $x \in E, 0 \le \mu_A(x) + \nu_A(x) \le 1$.

If A and B are two intuitionistic fuzzy sets of a non - empty set E then the following relations are valid [3]:

$A \subseteq B$ if and only if for all $x \in E$, $\mu_A(x) \le \mu_B(x)$ and $\nu_A(x) \ge \nu_B(x)$;

$A = B$ .if and only if for all $x \in E$, $\mu_A(x) = \mu_B(x)$ and $\nu_A(x) = \nu_B(x)$;

$\overline{A} = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}$;

$A \cap B = \{ (x, \min(\mu_A(x), \mu_B(x)), \max(\nu_A(x), \nu_B(x)) : x \, \varepsilon \, E \}$;

$A \cup B = \{ (x, \max(\mu_A(x), \mu_B(x)), \min(\nu_A(x), \nu_B(x))) : x \, \varepsilon \, E \}$.

Considering the degree of membership $\mu_A(x), \mu_B(x)$ and the non - membership $\nu_A(x), \nu_B(x)$ of each element $x \in E$ of the intuitionistic fuzzy sets A and B respectively of a non-empty set E the four types of induced intuitionistic fuzzy sets of E are defined as follows:

Definition 2.2 [6]: If A and B are two intuitionistic fuzzy sets of a non - empty set E then

$$A^{\circ}(B) = A^{\circ} = \{ (x, \mu_A(x), \min(\nu_A(x), \nu_B(x)) : x \in E \};$$
$$A_{\circ}(B) = A_{\circ} = \{(x, \mu_A(x), \max(\nu_A(x), \nu_B(x))) : x \in E\};$$
$$A^{*}(B) = A^{*} = \{ (x, \max(\mu_A(x), \mu_B(x)), \nu_A(x)) : x \in E \};$$
$$A_{*}(B) = A_{*} = \{(x, \min(\mu_A(x), \mu_B(x)), \nu_A(x) : x \in E)\}.$$

Note 2.3 [6]: It is to be noted that

$A^{\circ}(B) \neq B^{\circ}(A), A_{\circ}(B) \neq B_{\circ}(A), A^{*}(B) \neq B^{*}(A), A_{*}(B) \neq B_{*}(A)$.

III. SOME COMPLEMENT PROPERTIES OF INDUCED INTUITIONISTIC FUZZY SETS

In this section we have proved some properties of four different types of induced intuitionistic fuzzy sets and their complements corresponding to intuitionistic fuzzy sets A and B, of a set E, and their complements.

Property 3.1: $(\bar{A})^*(B) = \overline{A_\circ(\bar{B})}$

Proof: $(\bar{A})^*(B) = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}^*(B)$

$= \{(x, \max(\nu_A(x), \mu_B(x)), \mu_A(x)) : x \in E\}$

$= \overline{\{(x, \mu_A(x), \max(\nu_A(x), \mu_B(x))) : x \in E\}}$

$= \overline{\{(x, \mu_A(x), \max(\nu_A(x), \nu_{\bar{B}}(x))) : x \in E\}}$

$= \overline{A_\circ(\bar{B})}$.

Property 3.2: $(\bar{A})_*(B) = \overline{A^\circ(\bar{B})}$

Proof: $(\bar{A})_*(B) = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}_*(B)$

$= \{(x, \min(\nu_A(x), \mu_B(x)), \mu_A(x)) : x \in E\}$

$= \overline{\{(x, \mu_A(x), \min(\nu_A(x), \mu_B(x))) : x \in E\}}$

$= \overline{\{(x, \mu_A(x), \min(\nu_A(x), \nu_{\bar{B}}(x))) : x \in E\}}$

$= \overline{A^\circ(\bar{B})}$.

Property 3.3: $(\bar{A})^\circ(B) = \overline{A_*(\bar{B})}$

Proof: $(\bar{A})^\circ(B) = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}^\circ(B)$

$= \{(x, \nu_A(x), \min(\mu_A(x), \nu_B(x))) : x \in E\}$

$= \overline{\{(x, \min(\mu_A(x), \nu_B(x)), \nu_A(x)) : x \in E\}}$

$= \overline{\{(x, \min(\mu_A(x), \mu_{\bar{B}}(x)), \nu_A(x)) : x \in E\}}$

$= \overline{A_*(\bar{B})}$.

Property 3.4: $(\bar{A})_\circ(B) = \overline{A_*(\bar{B})}$

Proof: $(\bar{A})_\circ(B) = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}_\circ(B)$

$= \{(x, \nu_A(x), \max(\mu_A(x), \nu_B(x))) : x \in E\}$

$= \overline{\{(x, \max(\mu_A(x), \nu_B(x)), \nu_A(x)) : x \in E\}}$

$= \overline{\{(x, \max(\mu_A(x), \mu_{\bar{B}}(x)), \nu_A(x)) : x \in E\}}$

$= \overline{A_*(\bar{B})}$.

Property 3.5: $(\bar{A})^*(\bar{B}) = \overline{A_\circ(B)}$

Proof: $(\bar{A})^*(\bar{B}) = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}^*(\bar{B})$

$= \{(x, \max(\nu_A(x), \mu_{\bar{B}}(x)), \mu_A(x)) : x \in E\}$

$= \{(x, \max(\nu_A(x), \nu_B(x)), \mu_A(x)) : x \in E\}$

$= \overline{\{(x, \mu_A(x), \max(\nu_A(x), \nu_B(x))) : x \in E\}}$

$= \overline{A_\circ(B)}$.

Property 3.6: $(\bar{A})_*(\bar{B}) = \overline{A^\circ(B)}$

Proof: $(\bar{A})_*(\bar{B}) = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}_*(\bar{B})$

$= \{(x, \min(\nu_A(x), \mu_{\bar{B}}(x)), \mu_A(x)) : x \in E\}$

$= \{(x, \min(\nu_A(x), \nu_B(x)), \mu_A(x)) : x \in E\}$

$= \overline{\{(x, \mu_A(x), \min(\nu_A(x), \nu_B(x))) : x \in E\}}$

$= \overline{A^\circ(B)}$.

Property 3.7: $(\bar{A})^\circ(\bar{B}) = \overline{A_*(B)}$

Proof: $(\bar{A})^\circ(\bar{B}) = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}^\circ(\bar{B})$

$= \{(x, \nu_A(x), \min(\mu_A(x), \nu_{\bar{B}}(x))) : x \in E\}$

$= \{(x, \nu_A(x), \min(\mu_A(x), \mu_B(x))) : x \in E\}$

$= \overline{\{(x, \min(\mu_A(x), \mu_B(x)), \nu_A(x)) : x \in E\}}$

$= \overline{A_*(B)}$.

Property 3.8: $(\bar{A})_\circ(\bar{B}) = \overline{A^*(B)}$

Proof: $(\bar{A})_\circ(\bar{B}) = \{(x, \nu_A(x), \mu_A(x)) : x \in E\}_\circ(\bar{B})$

$$= \{(x, \nu_A(x), \max(\mu_A(x), \nu_B(x))): x \in E\}$$
$$= \overline{\{(x, \nu_A(x), \max(\mu_A(x), \mu_B(x))): x \in E\}}$$
$$= \overline{\{(x, \max(\mu_A(x), \mu_B(x)), \nu_A(x)): x \in E\}}$$
$$= \overline{A^*(B)} \ .$$

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