A Novel Complex Intuitionistic Fuzzy Set

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Abstract

Intuitionistic fuzzy set has been widely applied to decision-making, medical diagnosis, pattern recognition and other fields, because of its powerful ability to represent and address the uncertain of information. In this paper, we propose a novel complex intuitionistic fuzzy set.

Keywords: Uncertainty, Complex intuitionistic fuzzy set, Complex membership function.

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1. A novel model of complex intuitionistic fuzzy set

It is well known that fuzzy set is one of the most appropriate tool to solve many artificial intelligence problems, especially for common sense problems. Therefore, fuzzy sets are widely studied and extended [1, 2]. The novel complex intuitionistic fuzzy set is defined as follow.

Definition 1. A complex intuitionistic fuzzy set $\mathbb{A}$, defined on a universe of discourse U, is characterized by membership and non-membership functions $\mu^c_{\mathbb{A}}(x)$ and $\nu^c_{\mathbb{A}}(x)$, respectively, that assign any element $x \in U$ a complex-valued grade of both membership and non-membership in $\mathbb{A}$. By definition,

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the values of $\mu^c_{\mathbb{A}}(x)$, $\nu^c_{\mathbb{A}}(x)$, and their sum may receive all lying within the unit circle in the complex plane, and are on the form $\mu^c_{\mathbb{A}}(x) = \mu_{\mathbb{A}}(x)e^{i\theta_{\mu_{\mathbb{A}}}(x)}$ for membership function in $\mathbb{A}$ and $\nu^c_{\mathbb{A}}(x) = \nu_{\mathbb{A}}(x)e^{i\theta_{\nu_{\mathbb{A}}}(x)}$ for non-membership function in $\mathbb{A}$, where $i = \sqrt{-1}$, each of $\mu_{\mathbb{A}}(x)$ and $\nu_{\mathbb{A}}(x)$ are real-valued and both belong to the interval [0,1] such that $0 \leqslant \mu_{\mathbb{A}}(x)+\nu_{\mathbb{A}}(x) \leqslant 1$, also $\theta_{\mu_{\mathbb{A}}}(x)$ and $\theta_{\nu_{\mathbb{A}}}(x)$ are real-valued. Thus, the CIFS $\mathbb{A}$ is defined by:

$$\mathbb{A} = \{< x, \mu^c_{\mathbb{A}}(x), \nu^c_{\mathbb{A}}(x) > | x \in U\}, \tag{1}$$

where

$$\mu^c_{\mathbb{A}}(x) = \mu_{\mathbb{A}}(x)e^{i\theta_{\mu_{\mathbb{A}}}(x)} : U \longrightarrow \{\mu^c_{\mathbb{A}}(x) | \mu^c_{\mathbb{A}}(x) \in C, |\mu^c_{\mathbb{A}}(x)| \leqslant 1\}, \tag{2}$$

$$\nu^c_{\mathbb{A}}(x) = \nu_{\mathbb{A}}(x)e^{i\theta_{\nu_{\mathbb{A}}}(x)} : U \longrightarrow \{\nu^c_{\mathbb{A}}(x) | \nu^c_{\mathbb{A}}(x) \in C, |\nu^c_{\mathbb{A}}(x)| \leqslant 1\}. \tag{3}$$

$\pi^c_{\mathbb{A}}(x)$ is the hesitation function, which is the degree of uncertainty of the membership of element $x \in U$ to set $\mathbb{A}$. That is defined by the following equation:

$$\pi^c_{\mathbb{A}}(x) = 1 - \mu^c_{\mathbb{A}}(x) - \nu^c_{\mathbb{A}}(x). \tag{4}$$

References

[1] K. T. Atanassov, Intuitionistic fuzzy sets, in: Intuitionistic fuzzy sets, Springer, 1999, pp. 1–137.

[2] D. Ramot, R. Milo, M. Friedman, A. Kandel, Complex fuzzy sets, Fuzzy Systems IEEE Transactions on 10 (2) (2002) 171–186.