Intuitionistic Fuzzy Normal Operator on IFH - Space

A. Radharamani, S. Maheswari

Abstract: In this article, we define Intuitionistic Fuzzy Normal Operator operating on an IFH-Space. An operator $S$ is an intuitionistic fuzzy normal operator if $SS^* = S^*S$ i.e. $S$ commutes with its intuitionistic fuzzy adjoint.

Keywords: IFH-space, Intuitionistic fuzzy Adjoint operator (IF-A-operator), Intuitionistic Fuzzy Self-Adjoint operator (IFSA-operator), Intuitionistic Fuzzy Normal operator (IFN-operator).

I. INTRODUCTION

Let IFB($\mathcal{H}$) be the set of all IF-Bounded Linear Operators on IFH-Space $\mathcal{H}$. Park [5] first studied the concept of Intuitionistic Fuzzy Metric Spaces. Later on, Intuitionistic Fuzzy Metric and Norm have been defined by Saadati [6]. Then Goudarzi et al. [4] in 2009, introduced Intuitionistic Fuzzy Inner Product Space (IFIP-space), Majumdar and Samanta [9] defined IFIP-space in 2011. In 2018, Radharamani et al. [1], [2] have given the definition and properties of Intuitionistic Fuzzy Hilbert Space (IFH-Space) $\mathcal{H}$ as a triplet $(\mathcal{H}, \mathcal{F}_{\mu,\nu}, \tau)$ and also the concept of intuitionistic fuzzy adjoint and self-adjoint operators (IFA and IFSA-operators) in IFH-space. If $S \in$ IFB($\mathcal{H}$), $\langle Sx, y \rangle = (x, S^*y), \forall x, y \in \mathcal{H}$. Also $S$ is an IFSA-operator if $S = S^*$.

Now we introduced intuitionistic fuzzy normal operator on $\mathcal{H}$, if $SS^* = S^*S$. Here we establish some theorems and an example for intuitionistic fuzzy normal operator like addition and multiplication of intuitionistic fuzzy normal operator. $S$ is intuitionistic fuzzy normal if $S \Rightarrow S^*$.

II. PRELIMINARIES

Definition 2.1: [4]

A continuous $t$ - norm $\tau$ is called continuous $t$ - representable iff $\exists$ a continuous $t$ – norm $*$ and a continuous $t$ – conorm $t$ on the interval $[0,1]$ such that for all $x = (x_1, x_2), y = (y_1, y_2) \in L^*$, $\tau(x, y) = (x_1 * y_1, x_2 \circ y_2)$.

Definition 2.2: [4]

Let $\mu: V^2 \times (0, +\infty) \rightarrow [0,1]$ and $\sigma: V^2 \times (0, +\infty) \rightarrow [0,1]$ be Fuzzy sets, such that $\mu(x, y, t) + \sigma(x, y, t) \leq 1, \forall x, y \in V & t > 0$.

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An Intuitionistic Fuzzy Inner Product Space (IFIP-Space) is a triplet $(V, \mathcal{F}_{\mu,\nu}, \tau)$, where $V$ is a real Vector Space, $\tau$ is a continuous $t$ - representable and $\mathcal{F}_{\mu,\nu}$ is an Intuitionistic Fuzzy set on $V^2 \times \mathbb{R}$ satisfying the following conditions for all $x, y, z \in V$ and $s, r, t \in \mathbb{R}$:

(i) if $\mathcal{F}_{\mu,\nu}(x, y, 0) = 0$ and $\mathcal{F}_{\mu,\nu}(x, x, t) > 0$, for every $t > 0$.

(ii) if $\mathcal{F}_{\mu,\nu}(x, y, t) = \mathcal{F}_{\mu,\nu}(y, x, t)$.

(iii) $\mathcal{F}_{\mu,\nu}(x, x, t) \neq H(t)$ for some $t \in \mathbb{R}$ iff $x \neq 0$.

where $H(t) = 1, \text{ if } t > 0 \quad 0, \text{ if } t \leq 0$

(i) For any $\alpha \in \mathbb{R}$,

$\mathcal{F}_{\mu,\nu}(\alpha x, y, t) = \left\{ \begin{array}{ll}
\mathcal{F}_{\mu,\nu}(x, y, \frac{t}{\alpha}), & \alpha > 0 \\
H(t), & \alpha = 0 \\
\mathcal{F}_{\mu,\nu}(x, y, \frac{t}{\alpha}), & \alpha < 0
\end{array} \right.$

(ii) By putting $(x, y) = \mathcal{F}_{\mu,\nu}(x, y, 1)$, it is very simple to show that the Intuitionistic Fuzzy Inner Product acts quite similarly as the Ordinary Inner Product.

(iii) Schwarz inequality:

$\mathcal{F}_{\mu,\nu}(x, y, ts) = \mathcal{T}(\mathcal{F}_{\mu,\nu}(x, x, t^2) \mathcal{F}_{\mu,\nu}(y, y, s^2))$, for $x, y \in V$ and $s, t > 0$.

(iv) A sequence $(x_n) \subseteq V$ is called $\tau$-convergent to $x \in V$, if for any given $\epsilon > 0$ and $\lambda > 0$, $\exists N_0 \in \mathbb{Z}^+$, $N_0 = N_0(\epsilon, \lambda), \exists \mathcal{T}(x_n - x, \epsilon) > N_0(\lambda)$, whenever $n > N_0$.

(v) Let $\#(x)$ be a continuous linear function on $V$. Then it is said to be $\tau_{\mathcal{F}_{\mu,\nu}}$ - continuous, if $x_n \xrightarrow{\tau_{\mathcal{F}_{\mu,\nu}}} x \Rightarrow \#(x_n) \xrightarrow{\tau_{\mathcal{F}_{\mu,\nu}}} \#(x)$, for any $(x_n), x \in V$.

Theorem 2.4: [2]

Let $(V, \mathcal{F}_{\mu,\nu}, \tau)$ be an IFIP-Space, where $\tau$ is a continuous $t$ - representable for every $x, y \in V$, $\sup \{t \in \mathbb{R}: \mathcal{F}_{\mu,\nu}(x, y, t) < 1\} < \infty$. Define $\mathcal{F}_{\mu,\nu}: V \times V \rightarrow \mathbb{R}$ by $x, y \Rightarrow \mathcal{F}_{\mu,\nu}(x, y, t) = \sup_{t \in \mathbb{R}} \mathcal{F}_{\mu,\nu}(x, y, t) < 1$. Then $(V, \mathcal{F}_{\mu,\nu}(\cdot, \cdot))$ is an IFIP-space, so that $(V, \mathcal{F}_{\mu,\nu}(\cdot, \cdot))$ is a normed space, where $\mathcal{F}_{\mu,\nu}(x, t) = (x, x)^{1/2} \forall x \in V$. 

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Definition 2.5: [2]

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space with IP: \((x, y) = \sup \{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \}, \forall x, y \in V\). If \((V, F_{\mu, \nu}, T)\) is complete in the norm \(P_{\mu, \nu}\), then \(V\) is an Intuitionistic Fuzzy Hilbert Space (IFH-Space).

Theorem 2.6: [2]

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space with IP: \((x, y) = \sup \{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \}, \forall x, y \in V\). A sequence \((x_n)\) on \(V\) is \(\tau_{F_{\mu, \nu}}\)-convergent (i.e. \(x_n \xrightarrow{\tau_{F_{\mu, \nu}}} x\)) if \(x_n \xrightarrow{\tau_{F_{\mu, \nu}}} x\).

Proof:

Since \(x_n \xrightarrow{\tau_{F_{\mu, \nu}}} x\), we have

\[
\lim_{n \to \infty} P_{\mu, \nu}(x_n - x, \epsilon) = 0
\]

\[
\Rightarrow \lim_{n \to \infty} (x_n - x, x_n - x) = 0
\]

\[
\Rightarrow \sup \{ t \in \mathbb{R}^+: F_{\mu, \nu}(x_n - x, x_n - x, t) < 1 \} = 0
\]

\[
\leq \epsilon \sup \{ t \in \mathbb{R}^+: F_{\mu, \nu}(x_n - x, x_n - x, t) < 1 \} = 0
\]

Hence for any \(\epsilon > 0\) & \(0 < \lambda < 1\), we have

\[
\sup \{ t \in \mathbb{R}^+: F_{\mu, \nu}(x_n - x, x_n - x, t) < 1 \} = 1 - \lambda.
\]

So that, \(x_n \xrightarrow{\tau_{F_{\mu, \nu}}} x\).

Theorem 2.7: [2] (Riesz Theorem)

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space. For any \(\tau_{F_{\mu, \nu}}\)-continuous linear functional \(\theta\), a unique vector \(y \in V\), such that \(\forall x \in V\), we have \(\theta(x) = \sup \{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \}\).

Proof:

Continuous linear functional \(\theta\) is \(\tau_{F_{\mu, \nu}}\)-continuous if \(x_n \xrightarrow{\tau_{F_{\mu, \nu}}} x\) implies \(\theta(x_n) \xrightarrow{\tau_{F_{\mu, \nu}}} \theta(x)\) for any \(x_n \in V\).

If \(x_n \xrightarrow{\tau_{F_{\mu, \nu}}} x\), then by theorem (2.6), \(x_n \xrightarrow{\tau_{F_{\mu, \nu}}} x\). So \(\theta\) is continuous on IFH-Space like an ordinary Hilbert Space.

Therefore, by Riesz Representation Theorem, it is proved.

Theorem 2.8: [2]

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space, where \(T\) is continuous t-representable and sup \(\{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \} \leq \infty\). Then sup \(\{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \} = \sup \{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \}\) \(\forall x, y \in V\).

Definition 2.9: (IFA-operator in IFH-space) [2]

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space and let \(S \in IB(V)\). Then there exists unique \(S^* \in IB(V) \ni (Sx, y) = (x, S^*y) \forall x, y \in V\).

Definition 2.10: (IFSA-operator) [2]

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space with IP: \((x, y) = \sup \{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \}, \forall x, y \in V\) and let \(S \in IF(V)\). Then \(S\) is Intuitionistic Fuzzy Self-Adjoint Operator, if \(S = S^*\), where \(S^*\) is Intuitionistic Fuzzy Self-Adjoint of \(S\).

Theorem 2.11: [2]

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space with IP: \((x, y) = \sup \{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \}, \forall x, y \in V\) and let \(S \in IF(V)\). Then \(S\) is Intuitionistic Fuzzy Self-Adjoint Operator.

Theorem 2.12: [2]

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space with IP: \((x, y) = \sup \{ t \in \mathbb{R} : F_{\mu, \nu}(x, y, t) < 1 \}, \forall x, y \in V\) and let \(S \in IF(V)\). Then \(S\) is Intuitionistic Fuzzy Normal Operator if it commutes with its IF-Adjoint. i.e. \(SS^* = S^*S\).

III. MAIN RESULTS

In this section, we introduced the definition of Intuitionistic Fuzzy Normal Operator in IFH-Space and also explain some elementary properties of IFN-Operator in IFH-Space in detail.

Definition 3.1: (Intuitionistic Fuzzy Normal Operator)

Let \((V, F_{\mu, \nu}, T)\) be an IFIP-Space with an IP: \(\{u, v\} = \sup \{ t \in \mathbb{R} : F_{\mu, \nu}(u, v, t) < 1 \}\), \(\forall u, v \in V\) and let \(S \in IF(V)\). Then \(S\) is an Intuitionistic Fuzzy Normal Operator if it commutes with its IF-Adjoint. i.e. \(SS^* = S^*S\).

Remark 3.2:

1. It is obvious that every IFSA-operator is an IFN-operator.
2. If \(S\) is intuitionistic fuzzy normal and \(\alpha\) is a scalar, then \(\alpha S\) is also intuitionistic fuzzy normal.
3. The limit \(S\) of any intuitionistic fuzzy convergent sequence \(\{S_k\}\) of intuitionistic fuzzy normal operators is intuitionistic fuzzy normal.

Proof:

We know that \(S_k \xrightarrow{\tau_{F_{\mu, \nu}}} S_k\). So

\[
P_{\mu, \nu}(SS^* - S^*S)u, t) \leq P_{\mu, \nu}((SS^* - S_kS_k^*)u, t)
\]

\[
+ P_{\mu, \nu}((S_kS_k^* - S_kS_k^*)u, t)
\]

\[
\to 0
\]

Which implies that \(SS^* = S^*S\).
Theorem 3.3:

If $S_1$ and $S_2$ are IFN-operators on $(\mathcal{V},\mathcal{F}_{\mu,v})$ with the property that either commutes with IF-adjoint of the other, then $S_1 + S_2$ and $S_1S_2^*$ are IFN-operators.

Proof:
It is luminous by taking IF-adjoints that $S_1S_2^* = S_2^*S_1$ $\Leftrightarrow S_2S_1^* = S_1^*S_2$.
So, the assumption implies that each operator commutes with intuitionistic fuzzy adjoint of the other.

(a) We first prove that $S_1 + S_2$ is an IFN-operator as follows:

$$(S_1 + S_2)(S_1^* + S_2^*) = (S_1^* + S_2^*)(S_1 + S_2)$$

& $$(S_1 + S_2)(S_1^* + S_2^*) = (S_1 + S_2)(S_1^* + S_2^*)$$

Hence

$$(S_1 + S_2)^*(S_1 + S_2) = (S_1 + S_2)^*(S_1 + S_2)$$

Thus $S_1 + S_2$ is an IFN-operator.

(b) Next, we will show that $S_1S_2$ is an IFN-operator.

$$(S_1S_2)^*(S_1S_2) = (S_1S_2)^*(S_1S_2)$$

Thus $S_1S_2$ is an IFN-operator.

Theorem 3.4:

Let $(\mathcal{V},\mathcal{F}_{\mu,v})$ be an IFH-space with IP:

$$\langle u, v \rangle = \sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(u, v, t) < 1 \}, \forall u, v \in \mathcal{V}$$

and let $S \in \text{IFB}(\mathcal{V})$. $S$ is Intuitionistic Fuzzy Normal iff

$$(\mathcal{F}_{\mu,v}(S^*u, t)) = \mathcal{F}_{\mu,v}(S\mu, t) \forall u \in \mathcal{V}.$$

Proof:

Let $\mathcal{F}_{\mu,v}(S^*u, t) = \mathcal{F}_{\mu,v}(S\mu, t)$

$\Leftrightarrow \mathcal{F}_{\mu,v}(S^*u, t) = \mathcal{F}_{\mu,v}(S\mu, t)$

$\Leftrightarrow \sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(S^*u, t) < 1 \}$

$\sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(S\mu, t) < 1 \}$

$\sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(S^*u, t) < 1 \}$

$\sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(S\mu, t) < 1 \}$

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$\sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(S\mu, t) < 1 \}$

$\sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(S^*u, t) < 1 \}$

$\sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(S\mu, t) < 1 \}$

Remark 3.6:

Any complex number $z$ can be expressed uniquely as $z = a + ib$ where $a$ and $b$ are real numbers and that these real numbers are called real and imaginary parts of $z$. i.e.

$$a = \frac{z + \overline{z}}{2} \quad \text{and} \quad b = \frac{z - \overline{z}}{2i}.$$

The correlation between general operators and complex numbers and between IFSA-operators and real numbers suggests that for an arbitrary operator $S \in \text{IFB}(\mathcal{V})$, we form

$$T_1 = \frac{S + S^*}{2} \quad \text{and} \quad T_2 = \frac{S - S^*}{2i}.$$

$T_1$ and $T_2$ are clearly IFSA-operators and they have the property that

$$S = T_1 + iT_2.$$

The uniqueness of this expression for $S$ follows at once

$$S^* = T_1 - iT_2.$$

The operators $T_1$ and $T_2$ are called real part and imaginary part of $S$.

Theorem 3.7:

Let $(\mathcal{V},\mathcal{F}_{\mu,v})$ be an IFH-space with IP:

$$\langle u, v \rangle = \sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(u, v, t) < 1 \}, \forall u, v \in \mathcal{V}$$

and let $S \in \text{IFB}(\mathcal{V})$. $S$ is intuitionistic fuzzy normal iff its real and imaginary parts commute.

Proof:
Suppose that $T_1$ and $T_2$ are real and imaginary parts of $S$. So that

$$S = T_1 + iT_2 \quad \text{and} \quad S^* = T_1 - iT_2.$$

Then,

$$SS^* = (T_1 + iT_2)(T_1 - iT_2)$$

$$= T_1^2 + T_2^2 + i(T_2T_1 - T_1T_2) \quad \text{(3.5)}$$

$$S^*S = (T_1 - iT_2)(T_1 + iT_2)$$

$$= T_1^2 + T_2^2 + (T_2T_1 - T_1T_2) \quad \text{(3.6)}$$

It is clear that $T_1T_2 = T_2T_1$. Then from (3.5) & (3.6), $S^*S = S^*S$.

Conversely, if $S^*S = S^*S$, then

$$T_1T_2 = T_2T_1.$$

So, $2T_1T_2 = 2T_1T_1$

Implies that $T_1T_2 = T_2T_1$.

Example 3.8:

Let $(\mathcal{V},\mathcal{F}_{\mu,v})$ be an IFH-space with IP:

$$\langle u, v \rangle = \sup \{ t \in \mathbb{R} : \mathcal{F}_{\mu,v}(u, v, t) < 1 \}, \forall u, v \in \mathcal{V}$$

and let $S \in \text{IFB}(\mathcal{V})$ be an arbitrary (intuitionistic fuzzy) operator and if $\gamma$ and $\delta$ are scalars such that $|\gamma| = |\delta|$, show that $\gamma S + \delta S^*$ is intuitionistic fuzzy normal.
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Proof: From theorem 3.4, it is enough to prove $P_{\mu,\nu}((\gamma S + \delta S^*) + u_t) = P_{\mu,\nu}(\gamma S + \delta S^*)u_t$

Let us consider, $P_{\mu,\nu}(\gamma S + \delta S^*)u_t$

$P_{\mu,\nu}^2((\gamma S + \delta S^*)u_t) = ((\gamma S + \delta S^*)u_t, (\gamma S + \delta S^*)u_t)$

$= (\gamma S^* + \delta (S^*))u_t, (\gamma S^* + \delta (S^*))u_t)$

$= (\gamma S^* + \delta S^*)u_t, (\gamma S^* + \delta S^*)u_t)$

$= \sup \{ t \in \mathbb{R} : P_{\mu,\nu}((\gamma S^* + \delta S^*)u_t, (\gamma S^* + \delta S^*)u_t) < 1 \}$

$= \sup \{ t \in \mathbb{R} : P_{\mu,\nu}(\gamma S^* u_t, (\gamma S^* + \delta S^*)u_t) < 1 \}$

$= \sup \{ t \in \mathbb{R} : P_{\mu,\nu}(\gamma S^* u_t, (\gamma S^* + \delta S^*)u_t) < 1 \}$

Since $S^* = S$

$= \sup \{ t \in \mathbb{R} : P_{\mu,\nu}(\gamma S^* u_t, (\gamma S^* + \delta S^*)u_t) < 1 \}$

Therefore $\gamma S + \delta S^*$ is intuitionistic fuzzy normal.

IV. CONCLUSION

Here we conclude that the idea of Intuitionistic Fuzzy Normal Operator (IFN-Operator) in IFH-Space is moderately new. We endeavoured to prove a few properties of Intuitionistic Fuzzy Normal Operator in Intuitionistic Fuzzy Hilbert Space. By the consequences of this paper analysts can maturate Intuitionistic Fuzzy Functional Analysis.

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REFERENCES

1. A Radharamani S Maheswari and A Brindha, “Intuitionistic fuzzy Hilbert space and some properties”, Inter. J. Sci. Res. – (JEN), Vol. 8(9), 2018, 15-21.

2. A.Radharamani and S.Maheswari, “Intuitionistic Fuzzy adjoint & Intuitionistic fuzzy self-adjoint operators in Intuitionistic fuzzy Hilbert space”, Inter. J. Research and Analytical Reviews (IJRAR), Vol. 5(4), 2018, 248-251.

3. A.Radharamani, A.Brindha and S.Maheswari, “Fuzzy Normal Operator in Fuzzy Hilbert Space & its Properties”, International Journal of Scientific Research (JEN), Vol. 8(7), 2018, 1-6.

4. M.Goudarzi et al., “Intuitionistic fuzzy Inner Product space”, Chaos Solitons & Fractals, Vol. 41, 2009, 1105-1112.

5. J H Park, “Intuitionistic fuzzy metric spaces”, Chaos Solit. Fract., Vol. 22, 2004, 1039-1046.

6. R.Saadah & J. H. Park, “On the Intuitionistic Fuzzy Topological Spaces”, Chaos solitons & fractals, Vol. 27(2), 2006, 331-344.

7. K.Atanasov, “Intuitionistic fuzzy sets”, FSS, Vol. 20(1), 1986, 87-96.

8. P Majumdar and S K Samanta, “On intuitionistic fuzzy normed linear spaces”, Far East Journal of Mathematics, Vol. 1, 2007, 3-4.

9. P.Majumdar and S.K.Samanta, “On Intuitionistic fuzzy Inner Product Spaces”, Journal of fuzzy Mathematics, Vol. 19(1), 2011, 115-124.

10. S.Mukherjee and T. Bag, “Some properties of fuzzy Hilbert spaces”, Int. Jr. of Mat and Sci Comp, Vol. 1(2), 2010, 55.

11. P Majumdar and S K Samanta, “On intuitionistic fuzzy normed linear spaces”, Far East Journal of Mathematics, Vol. 1, 2007, 3-4.

12. M.Goudarzi and S.M.Vaizpour, “On the definition of fuzzy Hilbert space and its application”, J. Nonlinear Sci. Applications, Vol. 2(1), 2009, 46-59.

13. Rajkumar Pradhan & Madhumangal pal, “Intuitionistic fuzzy linear transformations”, Annals of Pure and Appl. Math., Vol. 1(1), 2012, 57-68.

14. T K Samanta & Iqbal H Jibril, “Finite dimensional intuitionistic fuzzy normed linear space”, International Journal of Open Problems in Computer Science and Mathematics, Vol. 2(4), 2009, 574-591.

15. G.Deschrijver et al., “On The Representation of intuitionistic fuzzy t-norms and t-conorms”, IEEE Trans. Fuzzy Syst., Vol. 12, 2004, 45-61.

16. G Deschrijver and E E Kerre, “On the Relationship Between Some Extensions of Fuzzy Sets and Systems, Vol. 133, 2003, 227-235.

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