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Analysis Of Neutrosophic Set, Julia Set In Aircraft Crash

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ABSTRACT

A neutrosophic fuzzy set that generalizes the classical set is represented by a closed interval *[0,1]*. Let us generalize the fuzzy set to the Neutrosophic set, which is defined as three membership functions between interval*]-0,1+ [*. This paper examines the bird collision problem within a more grounded Neutrosophic framework. The collision between the bird and the aircraft is represented in the Neutrosophic domain as a stationary point because it occurs at a distance too great for any other auditory signal to discern. Numerous methods exist for solving the airplane problem, including a Julia set in complex numbers. Bird collisions resulting from aircraft crashes add complication. An aviation signal is utilized to avoid an accident in a bird strike or bird collision.

Keywords: Neutrosophic set, Neutrosophic Fuzzy set, Fractals, Julia set, Bird collision.

1. INTRODUCTION

Lotfi.A. Zadeh introduced the Fuzzy set in 1965. Numerous real-world scenarios involving ambiguity and indeterminacy have found use for fuzzy sets and logic [19]. However, traditional fuzzy sets might not take member levels or membership values into account well, which might make it difficult to determine exact values in various situations. Interval-valued fuzzy sets were proposed to address the uncertainty of inclusion values; nonetheless, there are drawbacks to both conventional and interval-valued fuzzy sets [7]. In these situations, Atanassov's intuitionistic fuzzy sets provide some relief [2,6,10], but they might not be sufficient to handle conflicting and incomplete facts, which are common in systems of belief. Smarandache's neutrosophic sets provide a more thorough method of managing inaccurate and ambiguous data by extending conventional mathematical techniques [12].

Fuzzy systems (FS) are unable to solve the problem productively if the decision-maker's statement is confused regarding the correctness or improperness of the option [19]. Then, a few new hypotheses are needed to resolve the ambiguous issue. On the other hand, aside from being unexpected to the sets, the fuzzy method used in trade is vague and deficient [11]. Concurrently replicating the falsehood, indeterminacy, and truth values will produce a Neutrosophic set. Ye provided more straightforward Neutrosophic sets, which Peng et al. used to create their processes and operator groups [18]. Mathematician Benoit Mandelbrot is known to have used the term *fractal* for the first time in 1975. From the Latin word *fractus*, which means broken, Mandelbrot extended its application to patterns of geometry found in nature as well as the idea of conceptual fractional dimension [3,8,9]. Since there is only one genuine value, x, in neutrosophic statistics, this does not imply that x is also in $a + bI$ = N.

Rather, it means that $a + bx \in a + bI$. For this reason, it is necessary to present and study the appurtenance connection and equation [4,15,16].

Bird collisions claimed the lives of over 255 people in 1988; the first one happened in 1905 when Orville Wright hit a bird over an Ohio cornfield [1,14]. In the US, attacks by birds and other animals cost about 900 million dollars annually. Coyotes and deer are two examples of other wildlife attacks and aircraft [13]. The energy released during a collision is what causes serious financial and human repercussions and necessitates taking the possibility of a bird collision into account [17].

Recent work Utilizing a hybrid Eulerian-Lagrangian finite element formulation, the influence of an exceedingly deformable item on an inboard model has been effectively modeled. A prediction approach for aeronautical constructions must simulate harm in brass materials in composite and sandwich structures, operational parts in structure are typically constructed from items created by a range of resources [13]. The notion of a neutrosophic set is covered in Section 2 along with an example of how difficult it is to define the reasons for bird collisions. Aircraft accidents are caused by the complex number of bird strikes, and this shape which can be characterized as a Julia set may be discussed using a lemma and theorem.

2. METHODS

This section discusses the techniques used to look into bird collisions involving aircraft. It finds triangle-shaped collision patterns, which helps with hotspot identification and risk evaluation. By foreseeing collision hazards, this theory promotes the creation of predictive models, improving aircraft safety. All things considered, the Neutrosophic set theory advances our knowledge of bird-aircraft crashes and, by proactive steps and multidisciplinary collaboration, contributes to safer skies. The Neutrosophic set, which indicates that the birds make a triangle and strike the airplane with their bodies, is another name used to characterize these crashes. This idea applies only if there are several birds crashes taking place in the sky.

2.1 NEUTROSOPHIC SET

The phrase *neutrosophic set* refers to a set of elements that satisfy three conditions: functions T, I, and F: $Y \rightarrow [0,1]$ [4]. For instance, because a cloud's boundaries are unclear and its constituent element (a drop of water) belongs to the Neutrosophic probability set, the cloud is considered a Neutrosophic set [2,11]. They therefore don't know where the clouds begin or stop, nor if some elements are part of the set or not [12,18]. Furthermore, a higher percentage of indeterminacy is needed for a more precise estimate and a more seamless organic process [10].

2.2 SIMULATED BIRD COLLISIONS

The bird collision event is included in the category of soft-body collisions from a numerical perspective. Because of stresses that significantly exceed the material's strength, this period of hitches is considered by the impacting material's liquid-like performance [13]. Numerical barriers that are present in the simulation of these occurrences are mostly caused by this behavior as well [14,17]. The most crucial of these challenges is to accurately model the weight transfer that occurs through soft-body influence.

In the direction of completing the assignment and ensuring dependable outcomes, three key areas of the problem must be adequately mathematically addressed the constituent model of the bird substantial, the significant deformations of the numerical substitute bird model, and the flop and damage reproductions of the wedged structure [1,13].

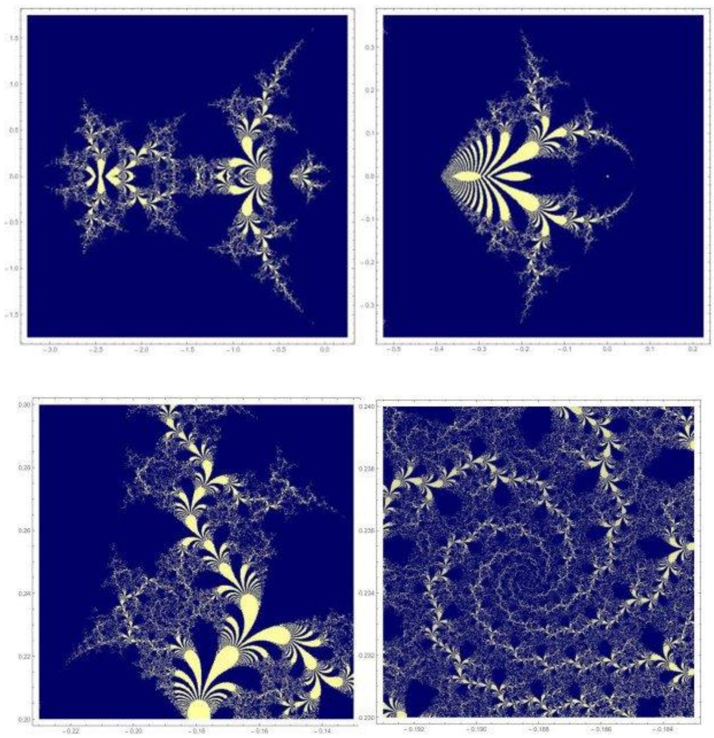

Figure 1 Birds Collision Complex

Examples

Several factors contribute to airplane crashes, including weather, aircraft mechanical issues, pilot experience, and training. The trio of Neutrosophic sets comprises.

i. There is little turbulence and a clear sky, according to the truth membership (T) weather prediction, indicating a minimal crash risk $T_{weather} = 0.2$. The weather forecast may have some indeterminacy (I) as unforeseen events could happen while the aircraft is in flight $I_{weather} = 0.6$. Although the prediction is usually correct, there is always a potential of inaccuracies or unanticipated weather phenomena Falsity membership (F) $F_{weather} = 0.1$.
ii. The likelihood of a mechanical breakdown is decreased when the aircraft truth membership (T) $T_{mechanical} = 0.2$.is subjected to routine maintenance inspections and found to be in excellent condition. Even with the Indeterminacy of membership $I_{mechanical} = 0.6$ maintenance checks, wear and tear or undiscovered problems might still present a danger to safety during the flight. Although Falsity membership (F) $F_{mechanical} = 0.2$ is uncommon, there is a remote chance that mechanical failures might still happen despite the tests.
iii. Due to their intensive training and wealth of expertise, Truth membership (T) pilots to help ensure safe operation $T_{pilot} = 0.3$. Unexpected events or exhaustion may have an impact on a pilot's performance during a flight, even with a membership (I) of indeterminacy $I_{pilot} = 0.5$. Although false membership (F) is rare, the pilot may have made mistakes or made a mistake in judgment $F_{pilot} = 0.2$.

2.3 NEUTROSOPHIC NUMBER OF APPURTENANCE

Let X be the universe and the Neutrosophic set *P* over *X* is defined as *P={(x, TP(x), IP(x), FP(X) :x* $P = \{(x, TP(x), IP(x), FP(x): x \in X\}$ where the truth P, Indeterminacy P, and Falsity P are said to be real or non-standard subsets of the interval i.e, $0^- \leq T_{p^y}$(x)+$I_{p^y}(y) + F_{p^y}(y) \leq 3^+$[15].

Examples

Complexity of Neutrosophic number [16]

i. Let I_1= [0,1], $N_1 = 2 + 3i\, I_1$

$$N_1 = 2 + 3i\,[0,1] = 2 + [3i.0, 3i.1] = 2 + [0,3i] = 2 + 0, 2 + 3i = [2, 2 + 3i]$$

$$N_1 = [2, -3 \pm \frac{\sqrt{9} - 4(1)(0)}{2(2)} = \left[2, -\frac{3\sqrt{9}}{4}\right]$$

$$= \left[2, -3 \pm \frac{3}{4}\right] = [2, (0, -0.75)]$$

ii. Let $I_2 = \{0.025, 0.065, 0.582\}$ which has a three element or finite discrete set like

$$N_2 = \{2 + 3i\{0.025, 0.065, 0.582\} = 2 + \{-0.0474, -0.195, -1.746\}$$

$$N_2 = 1.526, 1.805, 0.254 \subset [2, -0.75]$$

iii. Let $I_3 = \{\frac{1}{n}, 1 \leq n \leq \infty, n\ is\ an\ integer\}$ which is an infinite discrete set

$$N_3 = 2 + 3iI_3 = \left\{2 + 3i\frac{1}{n}, 1 \leq n \leq \infty, n\ is\ an\ integer\right\}$$

$$N_3 = \left\{2 + \left(3\frac{i}{1}\right), 2 + \left(\frac{3i}{2}\right), 2 + \left(\frac{3i}{3}\right), \ldots 2 + 3.\frac{1}{n}, \ldots\right\} = \subset [2, -0.75]\ .$$

2.1 Theorem

Let the Neutrosophic sets be in complex numbers. Then $p \in P$ *and* $q \in Q$,

i. *Addition* $p + q \in P + Q$

ii. *Subtraction* $p - q \in P - Q$

iii. *Multiplication* $p \times q \in P \times Q$

iv. *Division* $\frac{p}{q} \in \frac{P}{Q}$

v. *Power* $p^q \in P^Q$

Proof

Let $*$ any operations above, then
$P * Q = \{x * y; where\ x \in P, y \in Q\}$, and the operation $*$ is said to be well-defined. Then $x = p \in P$ and $y = q \in Q$ it seems to be of the form $p * q = P * Q$ [15].

2.4 JULIA SET

A complex fractal known as the Julia set is created when complex numbers are repeatedly used in a mathematical procedure. It displays geometric patterns that are complex and self-similar, frequently displaying chaotic and complicated behavior. These sets, which bear the name Gaston Julia after the French mathematician, are useful in dynamical systems, complex analysis, and computer graphics. They also provide light on the characteristics of complex numbers and how they behave in iterative systems [8].

If f^k k- stands for composition f ∘ ⋯ ∘ f the function f, $f^k(z)$ is iteration of k then f (f (· · · (f(z)) · · ·)) of z [14].

$$K(f) = \{z \in \mathbb{C} : f^k(z) \not\to \infty\} \qquad (1)$$

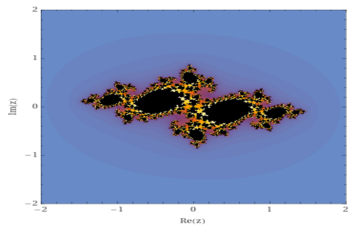

Figure 2 Julia set

2.1 Lemma

A polynomial $f(z) = a_n z^n + a_{n-1} z^{n-1} + \cdots + a_1 + a_0$ with n and $a_n \neq 0$, there are some s such that if $|z| \geq s$, then$|f(z)| \geq n|z|$. In certain, if $|f^m(z)| \geq s|$ for around m ⩾ 0, at that point $f^{(k)}(z) \to \infty$ ask → ∞. Hence, also $f^{(k)}(z) \to \infty$ or set $\{f^{(k)}(z)$: k = 0, 1, 2...} confined.

Proof

Considering that f(z) is a complex function. A polynomial with the form $a_n z^n + a_{n-1} z^{n-1} + \cdots + a_1 + a_0$ and $\{n, n-1, n-2, \ldots 2,1,0\}$ is given a complex function f(z).

A Polynomial such as $a_n z^n + a_{n-1} z^{n-1} + \cdots + a_1 + a_0$ with $\{n, n-1, n-2, \ldots 2,1,0\}$ is desirable to explain that $f^{(k)}(z) \to \infty$.It can indicate is appropriately high to confirm that if $|z| \geq s$, then

$$\frac{1}{2}\ |a_n||z^n| \geq n\,|z| \text{ and } (|a_{n-1}|\ |z^{n-1}| + \cdots |a_1||z| + |a_0|) \leq \frac{1}{2}\ |a_n||z^n|\ ) \quad (2)$$

Then, if absolute $|z| \geq s$,

$$|f(z)| \geq |a_n|\ |z^n| - (|a_{n-1}|\ |z^{n-1}| + \cdots |a_1|\ |z| + |a_0|) \geq |a_n||z^n| \ \ \geq n|z| \quad (3)$$

Also, if $|f^m(z)| \geq s|$ for about m, then put on this inductively, then $|f^{m+k}(z)| \geq 2^m\ |f^k(z)|$, then $|f^m(z)| \to \infty$ [8].

2.2 Theorem

Let $f(z)$ be an analytic mapping in $G \subset \mathbb{C}$ such that $f(p) = p$ for about p in G. Then

(a) $|f'(p)| < 1$ then iff *p is an attracting fixed point,*

(b) $|f'(p)| > 1$ then iff *p is a repelling fixed point.*

Proof

Let $|f'(p)| = 0$, p is said to be *super attracting fixed point* and $|f'(p)| = 1$, p is said to be a *neutral fixed point*. It has intricate behavior.

It is possible to reveal a partially repellent and partially appealing nature. Sample of a neutral fixed point at $p = 0$ for the complex function $f(z) = \sin(z)$. P qualities in real-valued seeds, while $p = 0$ in fully imaginary-valued seeds has a repellent quality. For $z = bi$, $b \in \mathbb{R}, \sin(bi) = isinh(b)$. Then sin h(b) said to be an increasing function, for all $b \in \mathbb{R}^+$, { $sin^m(bi)\} \to \infty$ as $n \to \infty$ and for all $b \in \mathbb{R}^-$, { $sin^m(bi)\} \to -\infty$. Similarly, neutral fixed points are either an attracting or repelling fashion [8].

2.5 AIRPLANE CRASHES

The majority of large species with tremendous populations that are involved in bird collisions in the United States are geese and gulls. While feral Canada geese and Greylag geese populations are rising in rough areas of the European Union, raising the hazard of those enormous birds to aircraft, migratory snow geese and Canada populations have improved significantly in some areas of the US [1].

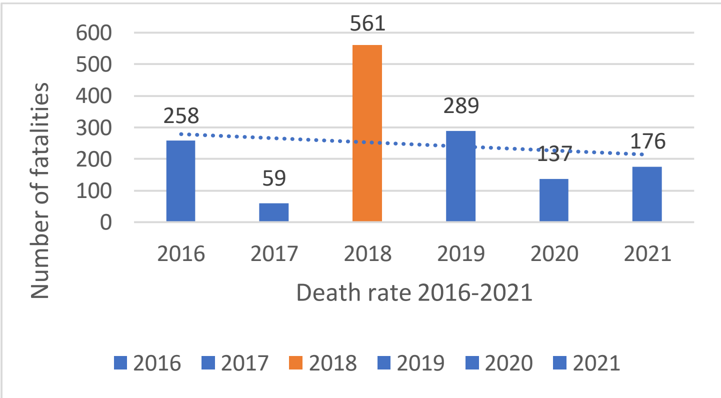

Figure 3 Number of worldwide air traffic fatalities from 2016 to 2021

In various regions globally, there is frequent interaction between sizable predatory birds like Milvus kites and Gyps vultures [9]. In the United States, the predominant species encountered include waterfowl (30%), gulls (22%), and raptors (20%), alongside pigeons and doves (7%) [13]. According to the Feathers Recognition Lab at the Smithsonian Institution, turkey vultures pose the highest risk, with Canada geese and white pelicans following closely behind in terms of potential hazards [14,17].

Figure 4 Complex Number of birds forms Julia set

Figure 4 shows geometric arrangements that are complex and chaotic, as complex numbers representing bird locations converge to form a Julia set. This depiction demonstrates the intricacy of the birds' movement patterns while capturing the dynamic interactions between them in their natural habitat. The Julia set highlights the complex dynamics found in avian populations and their influence on ecological systems by providing insights into the emergent behaviors and interactions among individual birds.

3. RESULTS

A bird strike occurs when an aircraft while it is in the air, generally on takeoff or landing. This bird crash might have been triggered by an aviation disaster in 2016 or 2021 and it may also be represented as a Neutrosophic set forms a complexity of neutrosophic numbers is explained in subsection 2.3 examples. A bird collision creates a Julia set (lemma 2.1) whose form is defined by the shape of the bird. The bird assaults the aircraft in opposing directions. This bird strike shape in Fig 2 is said to be the same shape as Julia set's fractal dimension in connectivity to another, more in-depth analysis of bird strike. It is discussed in the lemma, theorem, and section 2 about airplane crashes. Then Figure 4 depicts a triangle-shaped bird strike that appears to be sophisticated. It could symbolize the complex numbers of the Neutrosophic set and the Julia set's form.

Note:

- *[0,1]* denotes the membership values in the Fuzzy set.
- *]-0,1+ [* denotes that the membership functions of the Neutrosophic set.

4. CONCLUSION

This research uses the phrases Julia set and Neutrosophic set to distinguish between two concepts related to bird crashes in airplanes. The three categories indicate the interval*]-0,1+ [* remain stated in the Neutrosophic set. Because of their middle value, the Neutral term and the Fixed point of the neutrosophic indeterminacy are comparable. For instance, the middle value of the first and last membership functions, *[0,1],* is 0.5. However, there are some comparable events in bird crashes, and Julia set is an accumulation of the limit points of the entire reversed orbit. It is an array of a finite number of elements that, with repetition, converge to an infinite. Julia's set is a complex integer set that is elaborated with some examples above with bounded iterated values.

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