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A note on AntiGeometry and NeutroGeometry and their application to real life

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Abstract: Dealing with NeutroGeometry in true, false, and uncertain regions is becoming of great interested for researchers. Not too many studies have been done on this topic, for that reason, aim of this work is to define a new method to deal with NeutroGeometry in true, false, and neutrogeometry (T,C,I,F). Furthermore, some real-life application examples in 3D computer graphics, Astrophysics, nanostructure, neutrolaw, neutrogender, neutrocitation, neutrohealth-food, neutroenvironment and quantum space are presented.

Keywords: Neutrosophic logic, neutroGeometry, antiGeometry, neutrosophic theory, Non-Euclidian geometry, Euclidian geometry, neutroAlgebra, antiAlgebra.

1. Introduction

Neutrosophy is a new branch of philosophy which was introduced by (Smarandache, 2002) which has been of great interesting of researchers who study different topics (applied or pure science) and it studies the origin, nature and scope of neutralities, as well as their interactions with different ideational spectra: (B) is an idea, proposition, theory, event, concept or entity; anti (B) is the opposite of (B); and (neut-B) means neither (B) nor anti (B), i.e. neutrality between the two extremes (Bal eta l., 2018). Its fundamental theory states that every idea <B> tends to be neutralized, diminished, balanced by <nonB> ideas (not only <antiB> as Hegel). <noB> = what is not <B>, <antiB> = the opposite of <B>, and <neutB> = what is neither <B> nor <antiB>. In their classical form <B>, <neutB>, <antiB> are disjointed two by two. Smarandache (2002) defined fundamental notion of neutrosophic sets in the following way: Let R be an universe and N be a subset of R. An element y of R is written with respect to the set N as y (T, I, F) and belongs to N as follows: t% of true, i% of indeterminacy (unknown) and f% of false , where t belongs to T, i belongs to I and f belongs to F. Statically T, I, F are subsets, but dynamically T, I, F are functions or operators that depend on many known and unknown parameters. Following the idea of neutrosophic theory, many topics have been developed such that neutrosophic topology, neutrosophic normed spaces, neutrosophic probability, neutrosophic probability, decision making, neutroAlgebra, neutroGeometry and so on.

In our real world, spaces are not homogeneous, but mixed, complex, even ambiguous. The elements that populate them and the rules that act on them are not perfect, uniform or complete but fragmented and disparate, with unclear and contradictory information, and are not applied in the same degree to each element. The perfect, idealistic, exist only in the theoretical sciences. We live in a

multi-space endowed with a multi-structure (Smarandache, 2021). Neither the elements of space nor the rules that govern them are egalitarian, all of them are characterized by degrees of diversity and variation. Indeterminate data and procedures (vague, unclear, incomplete, unknown, contradictory, ignorance, etc.) surround us.

While Non-Euclidean Geometries result from the total negation of a single specific axiom (Euclid's Fifth Postulate), AntiGeometry results from the total negation of any axiom and even more axioms of any geometric axiom system (Euclid's Five Postulates). Therefore, NeutroGeometry and AntiGeometry are respectively alternatives and generalizations of Non-Euclidean Geometries.

Smarandache (2021) proposed: Let's consider a classical geometry concept, it forms the following geometric neutrosophic triplet:

Concept(1, 0, 0), NeutroConcept(T, I, F), AntiConcept (0, 0, 1).

Where $(T, I, F) \notin \{(1, 0, 0), (0, 0, 1)\}$.

Concept(1, 0, 0) means that the degree of truth of the concept is T = 1, I = 0, F = 0, or the Concept is 100% true, 0% indeterminate, and 0% false in the given geometric space.

NeutroConcept (T, I, F) means that the concept is T% true, I% indeterminate, and 0% false in the given geometric space, with $(T, I, F) \in [0, 1]$, and $(T, I, F) \notin \{(1, 0, 0), (0, 0, 1)\}$.

AntiConcept (0, 0, 1) means that T = 0, I = 0, and F = 1, or the Concept is 0% true, 0% indeterminate, and 100% false in the given geometric space.

Smarandache (2021) went from the neutrosophic triplet (Algebra, NeutroAlgebra, AntiAlgebra) to a similar neutrosophic triplet (Geometry, NeutroGeometry, AntiGeometry), in the same way. Correspondingly from the algebraic structuires, with respect to the geometries, one has in the classical (Euclidean) Geometry, on a given space, all classical geometric Concepts are 100% true (i.e. true for all elements of the space). While in a NeutroGeometry, on a given space, there is at least one NeutroConcept (and no AntiConcept). In the AntiGeometry, on a given space, there is at least one AntiConcept.

With a view to device a practical tool for inference, Belnap (1977) introduced the notion of a four-valued logic. In his work, corresponding to a certain information he considered four possibilities namely T: True, F: False, none: neither true nor false, and both: both true and false. He symbolized these four truth values as {T, F, both, none}, for more notions derived from this paper, we refer the reader to (Das, et al., 2021; Mohanasundari and Mohana, 2020).

Later on (Smarandache, 2013) Smarandache has generalized Belnap's Logic (True, False, Unknown, and Contradiction), Lukasiewicz' Logic (True, False, and Possible), and Kleene's Logic (True, False, Unknown (or Undefined)) to Refined Neutrosophic Set having any $n \geq 2$ components, where the Truth T was split into Sub-Truths T_1, T_2, …, T_p, the Indeterminacy I was split into Sub-Indeterminacies, I_1, I_2, …, I_r, and the Falsehood F was split into Sub-Falsehoods F_1, F_2, …, F_s, where p, r, s ≥ 0, are positive integers and at least one of them is ≥ 2, with p+r+s = n.

Therefore, he also extended the Fuzzy Set to Refined Fuzzy Set, Intuitioinoistic Fuzzy Set to Refined Intuitionoistic Fuzzy Set, and similarly for other fuzzy extension sets.

In the case of Belnap's Logic, the Indeterminacy was split into two sub-indeterminacies: I_1 = Unknown, and I_2 = Contradiction.

In this work, we use the notions presented by (Singh, 2022) and (Smarandache, 2021), to carry out an exhaustive analysis of the NeutroGeometry in the cases in which the indeterminacy is divided into two categories, ignorance and contradiction as is was proposed by Smarandache (2013) in n-refined neutrosophic logic; given that these cases can occur in real life and are first line, in this way, several application examples are presented where this sort of act can occur. Additionally, a method for dealing with NeutroGeometry in true, false and neutrality (or indeterminacy) (T,C,I,F) is presented, where T is true, C is contradiction, I is ignorance and F is false. Throughout the development of this work, neutrogeometry (T,C,I,F) will also be written as neutrogeometry.

2. BACKGROUND

It is well-known that Euclidian-geometry is one of the oldest disciplines of mathematics. Its origin etymological, gives us a clear idea of the activities to which it appears related in its beginnings. This is how many historians find the roots of this science in ancient Egypt, where the foundations geometry solids by simply introducing the measurement of land with the surveyors, who after the annual floods of the Nile, had the task of rebuilding the boundaries of the lands assigned to the settlers, or also linked to the construction of its famous pyramids According to Salazar (1984) The development of modern geometry was carried out by the mathematician German David Hilbert (1862-1943), who made an analysis of Euclidean-geometry in his work Foundation of geometry (1899), reaching the conclusion that only six primitive concepts (point, line, plane, belongs, congruence and between) and 21 postulates, which lay the solid foundations of geometry, thus becoming a science rational and deductive, of which its components are independent, categorical and enough.

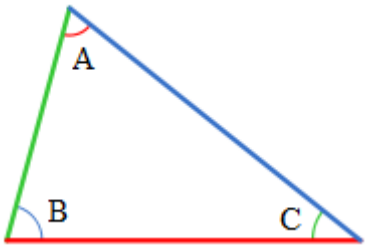

Figure 1: The sum of angles A, B and C in the given triangle is 180° as per Euclidian geometry i.e., A+B+C=180°

On the other hand, it is called non-Euclidean geometry, to any formal system of geometry were different postulates and propositions in some matter from those established by Euclid in his treatise elements.

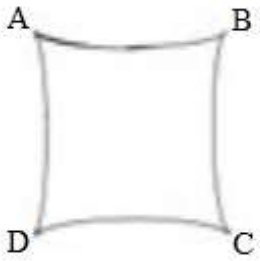

Figure 2: An illustrative example of non-Euclidian geometry

There is not a single system of non-Euclidean geometry, but many, although if the discussion is restricted to homogeneous spaces, in which the curvature of space is the same at each point, in which the points of space are indistinguishable, three formulations of geometries:

I. Euclidean geometry satisfies all five of Euclid's postulates and has zero curvature (i.e., it is assumed to be in flat space so the sum of the three interior angles of a triangle is always 180°).

II. Hyperbolic geometry satisfies only Euclid's first four postulates and has negative curvature (in this geometry, for example, the sum of the three interior angles of a triangle is less than 180°).

III. Elliptic geometry satisfies only Euclid's first four postulates and has positive curvature (in this geometry, for example, the sum of the three interior angles of a triangle is greater than 180°).

IV. Spherical geometry is the geometry of the two-dimensional surface of a sphere. It is an example of non-Euclidean geometry. Spherical geometry is the simplest model of elliptical geometry, in which a line has no parallel lines through a given point. In contrast to hyperbolic geometry, in which a line has two parallels, and an infinite number of ultra-parallels, through a given point.

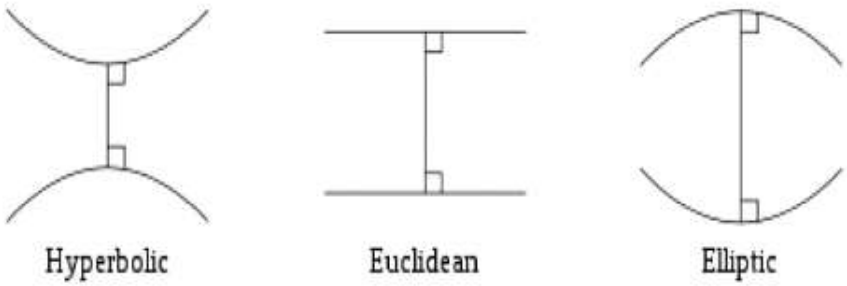

Figure 3: An illustrative example of difference between Euclidian and non-Euclidian geometry

II, III, IV are particular cases of Riemannian geometries, in which the curvature is constant, if the possibility that the intrinsic curvature of the geometry varies from one point to another is allowed, we have a case of general Riemannian geometry, as it happens in the theory of general relativity where gravity causes an inhomogeneous curvature in space-time, the curvature being greater near concentrations of mass, which is perceived as an attractive gravitational field. Smarandache (2021) said that Riemannian geometry, which is called elliptic geometry, is an antigeometry too, since the fifth Euclidean postulate is 100% invalidated in the following antipostulate (second version) place, through a point outside of a line, no parallel can be drawn to that line or (T,I,F)=(0,0,1). Since in this paper indeterminacy factor consists of two divisions namely contradiction (C) and ignorance (I) (Chatterjee et al., 2016), through a point outside of a line, no parallel can be drawn to that line or (T,C,I,F)=(0,0,0,1). This means that for this concept, we form the following geometric neutrosophic triplet:

Concept(1, 0, 0, 0), NeutroConcept(T, C, I, F), AntiConcept (0, 0, 0, 1).

Where (T, C, I, F) ∉ {(1, 0, 0, 0), (0, 0, 0, 1)}.

Concept(1, 0, 0, 0) means that the degree of truth of the concept is T = 1, C=0, I = 0, F = 0, or the Concept is 100% true, 0% contradiction, 0% ignorance and 0% false in the given geometric space.

NeutroConcept (T, C, I, F) means that the concept is T% true, C% contradiction, I% ignorance and 0% false in the given geometric space, with (T, C, I, F) ∈ [0, 1], and (T, C, I, F) ∉ {(1, 0, 0,0), (0, 0, 0, 1)}.

AntiConcept (0, 0, 0, 1) means that T = 0, C = 0, I=0 and F = 1, or the Concept is 0% true, 0% contradiction, 0% ignorance and 100% false in the given geometric space.

We go from the algebraic structures, with respect to the geometries, one has in the classical (Euclidean) Geometry, on a given space, and all classical geometric Concepts are 100% true. While in a NeutroGeometry, on a given space, there is at least two NeutroConcept (and no AntiConcept). In the AntiGeometry, on a given space, there is at least one AntiConcept.

How to deal with these sort of phenomenon and characterize them in true, false, or uncertain regions in which these uncertain regions are divided in two parts (contradiction and ignorance) is one of the most crucial tasks. Recently, Singh (2022) presented a method for dealing with one type of indeterminacy, therefore, in the next section, we propose a method to deal with these types of information in neutrogeometry (when indeterminacy is divided in contradiction and ignorance) for multi-decision process and we show some application examples in real life, this method is an extension of the method proposed by (Singh, 2022), but the method proposes in the next section is more general that the method proposed by (Singh, 2022).

3. Method to deal with NeutroGeometry in true, false, and indeterminacy and its application to real life

Step 1. Consider the information with a geometry and its attributes (B).

Step 2. Let B be any non-empty set of a given geometrical information.

Step 3. Define the operator as $\varphi: B \times B \rightarrow P^m(B)$ as (T,C,I,F) ∉ {(1,0,0,0),(0,0,0,1)}.

Step 4. In case any mapping is possible, then it can be characterized by:

I. In case for any elements t, u ∈ B, the geometry provides a new element in the geometrical space, i.e., t ∘ u ⊆ B. It can be considered as true characterization.

II. In case for any elements t, u ∈ B, the geometry provides a new element which does not exist in the geometrical space using the given operator as t ∘ u ⊈ B. It can be considered as false regions.

III. In case for any element of t, u ∈ B, the geometry provides a new element which in saddle space and its quantum state is uncertain and it is divided in two unknown parts. This type of element can be considered in neutrogeometry.

Step 5. It defined a function $\vartheta: T \to U$, which provides three possibilities:

I. In case a well-defined mapping exists among t and u, then it is called as true regions.

II. In case the mapping is outer-defined mapping between t and u, then it is in false regions.

III. It is unknown whether the mapping exists or not and it thinks but not sure what is the value for the mapping among t and u then the element is in neutrogeometry.

Step 6. In this way, the geometrical space and its characterization can be possible.
Step 7. The similarity among the information sets can be found using the geodesic distance.
Step 8. The geodesic distance provides the shortest path among two neutrogeometric spaces rather than its straight line distance of Euclidean geometry as shown in figure 4.
Step 9. The information shading to the defined geodesic distance can be considered as cluster for knowledge processing tasks.

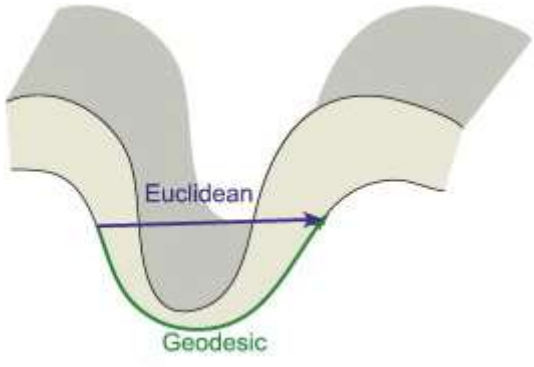

Figure 4: The difference between Euclidean and geodesic distance

Next, we show some applications with non-Euclidian geometry and NeutroGeometry.

Application 1: Consider there are *m* non-Euclidean information sets in a given space. Defining the function will take $O(m^2)$ time complexity among them. The characterization of those information sets in neutrogeometry will take maximum $O(m^2)$ time complexity. In this way, the overall time

complexity for characterization of non-Euclidean information in true, false, contradiction, ignorance regions may take maximum $O(m^3)$ time complexity.

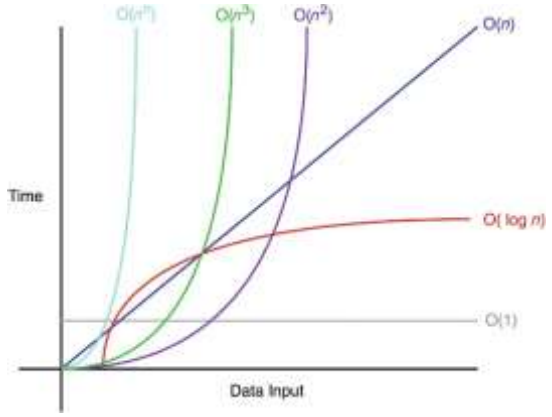

Figure 5: A NeutroGeoemtry time complexity information and its visualization

Application 2: Astrophysics is the development and study of physics applied to astronomy. It studies stars, planets, galaxies, black holes and other astronomical objects as physical bodies, including their composition, structure and evolution. Astrophysics uses physics to explain the properties and phenomena of stellar bodies through their laws, formulas and magnitudes. The beginning of astrophysics was possibly in the 19th century when, thanks to the spectra, the physical composition of the stars could be ascertained. Once it was understood that the celestial bodies are composed of the same ones that make up the Earth and that the same laws of physics and chemistry apply to them, astrophysics was born as an application of physics to the phenomena observed by the Earth astronomy. Astrophysics is therefore based on the assumption that the laws of physics and chemistry are universal, that is, that they are the same throughout the universe (Ginzburg, 1979). In this way, Astrophysics is a branch of information with NeutroGeometry. The representation of astronomy and its pattern is based on spherical geometry and its algebra as shown in figure 6.

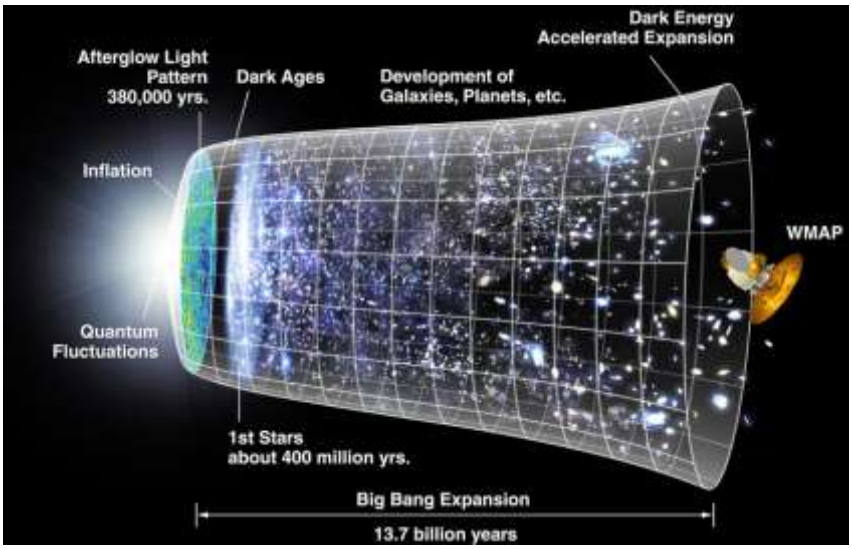

Figure 6: A NeutroGeoemtry astrophysics information and its visualization

Application 3: A nanostructure is a structure with an intermediate size between molecular and microscopic (micron-sized) structures. Here we are talking about the nanoscale. Generally, these structures experience quantum effects that are not as obvious in larger structures and therefore have special physical properties (Farrow et al., 2007). This case can be represented by Riemannian geometry as can be seen in figure 7.

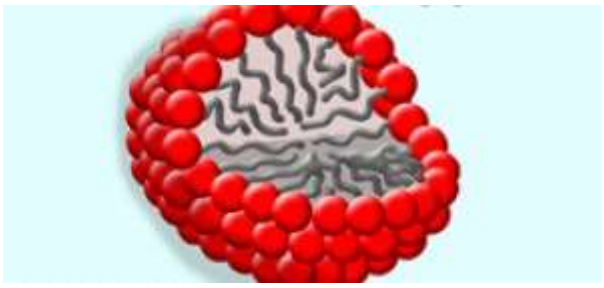

Figure 7: A NeutroGeoemtry nanostructure information and its visualization

Application 4: In 3D computer graphics (abbreviated CG) is a method of improving the quality of a texture on a surface that is viewed from an oblique angle relative to the projection angle of the image. Texture on a surface, like bilinear filtering and trilinear filtering, anisotropic filtering removes aliasing, but it differs from the previous methods in that it reduces blurring and preserves detail at extreme viewing angles. Anisotropy filtering is relatively heavy (mainly because of memory usage and some amount of computational processing) and only became a standard feature on commercial graphics cards in the late 1990s. Computer graphics is now common in modern boards and can be activated and configured both by the user from the driver configuration, or by graphic applications or video games using programming tools as can be seen in figure 8.

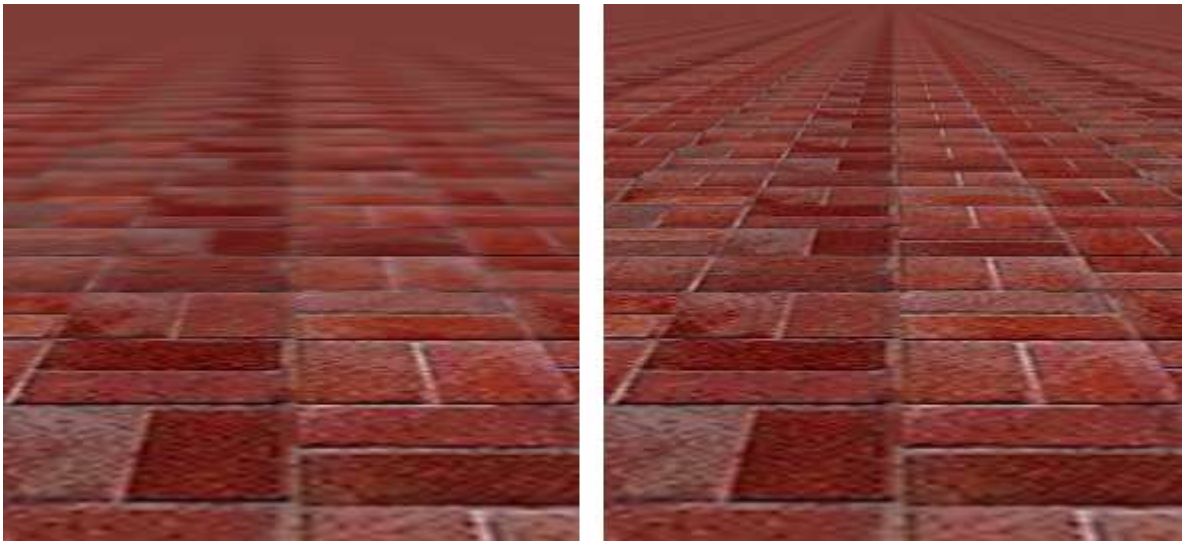

Figure 8: A NeutroGeoemtry computer graphic information and its visualization

This can be done via steeply angled rather than right angled with respect to the given point which required neutrogeometry. This can be characterized as follows:

I. True image (1,0,0,0): In case the true image is made via enhancing the image which can be represented as (1, 0, 0, 0).

II. False image (0,0,0,1): The image does not provide the true image or provide distinct results can be represented as (0, 0, 0, 1).

III. NeutroImage (T, C, I, F): The expert is uncertain about the image and its quality after the enhancement, this means that he/she does not too much about the topic and the does not if the image quality will be as he/she thought.

Application 5: The law in any country is totally uncertain and vague (Singh, 2021; Smarandache, 2021; Kappor and Singh, 2020; Singh, 2022). It depends on hierarchical ordering of citizens and their positional power in the given country which is a neutrogeometric information rather than flat. There are several cases where the same punishment will not be given to each citizen for the same act. This can be defined by:

I. Law (1, 0, 0, 0): In case the given law is fully applied on the particular citizen. in this case, the government or court can be considered as unbiased.

II. AntiLaw (0, 0, 0, 1): in this case, there is no law defined for the particular act. It used to be observed when a politician or business class people never get punishment under the same law.

III. NeutroLaw (T,C,I,F). In this case, the law changes based on person to person, region to region, and, religion to religion. Besides, some laws presented by governments usually

contradict what is present in some other decree or do not agree to propose a new law, in turn, there is a high level of ignorance among people, given that they do things out of ignorance and not knowing the law does not exempt them from responsibility. This type of law where partial influence occur by any government or higher authority can be considered as neutro-law. So, the law differs into indeterminacy which is divided in ignorance and contradiction, the hidden pattern in these types of information can be analyzed using neutrogeometry.

Application 6: Neutro-gender law is one of the most suitable examples of neutrogeoemtry information (Singh, 2022) where the law differs based on the gender. This can be characterized as follows:

I. Women law (1, 0, 0, 0): Consider, a woman complains that a man did sexual or mental harassment to her. In this case, the given crime can be accepted immediately without proper proof also.

II. Men Law (0, 0, 0, 1): Consider, a man complains because he suffered sexual abuse by a woman or was psychologically violated. In this case, the given crime cannot be accepted right away with providing several proofs also.

III. NeutroLaw (T,C,I,F): In case a person who belongs to LGBT community reports about sexual or mental abuse, sometimes nobody body listens, sometimes nobody does not what to do, the laws are not clear for these types of people since there is a contradiction if should be care as a man or as a woman . The law differs for them which shows indeterminacy which is divided in ignorance and contradiction. In this case, the entire information can be considered as uncertain and vague.

Application 7: The characterization of a citation for intellectual measurement cannot be done via flat way like Euclidean geometry (Singh, 2022; Smarandache, 2021). It requires neutrogeometry classification which can be characterized as follows:

I. Citation (1, 0, 0, 0): A paper cited by the domain expert, keyword, or methodology matching for the given topic can be considered as relevant citation (1, 0, 0, 0).

II. Anti-Citation (0, 0, 0, 1): A paper cited in irrelevant way, a retracted paper citation, a posthumous authors papers citation, same departmental citations beyond the relevant of topic, host conference citation without relevancy, forced citation, and random citation can be considered as Anti-Citation (0, 0, 0, 1).

III. Neutro-Citation (T,C,I,F): An article that is self-cited, influenced citations, citations added because peer review was required, articles published in predatory journals, etc. It can be considered a Neutro-Citation (T,C,I,F).

Application 8: Quantum field theory in curved space-time is an extension of standard quantum field theory in which the possibility is contemplated that the space-time through which the field propagates is nevertheless not flat (described by the metric of Minkowski). A generic prediction of this theory is that particles can be generated due to time-dependent gravitational fields, or the presence of horizons Quantum field theory in curved space-time may be required as a first approximation of quantum gravity. The next step consists of a semi classical gravity, in which quantum corrections will be taken into account, due to the presence of matter, on space-time as can be seen in figure 9. In this way, the traversal criteria do not matter whether you go x steps right and then you go y steps forward and vice versa (Bresar, 2014). It means the non-commutative geometry cannot be represented precisely which requires fuzzy spherical coordinates.

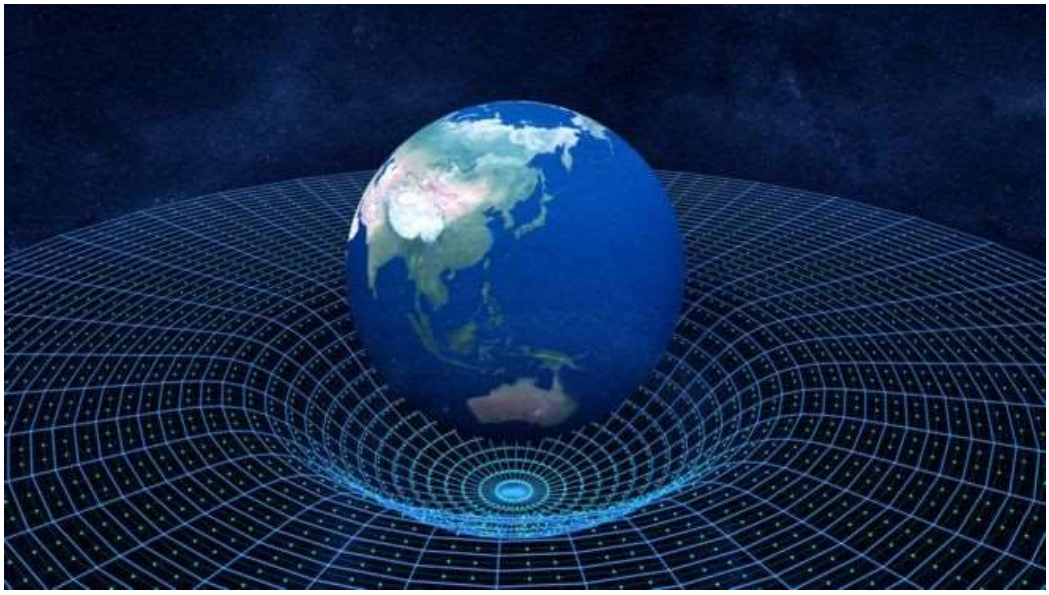

Figure 9: A NeutroGeoemtry Quantum space information and its visualization

Application 9: The way in which we consume perishable foods is something that we do not know and we cannot exactly measure whether they are healthy or not, since the companies that produce, mention that they are made under strict health protocols, while some foundations question these methods, since they mention that these are harmful to health. So, it requires non-Euclidean classification which can be characterized as follows:

I. Health-food (1, 0, 0, 0): People who eat healthy without consuming perishable products for the given topic can be considered as relevant Health-food (1, 0, 0, 0).

II. Anti-Health-food (0, 0, 0, 1): People who eat unhealthy food and/or perishable products, knowing how bad these can be for their health. This can be considered as Anti-Health-food (0, 0, 0, 1).

III. Neutro-Health-food (T,C,I,F): People who claim to take care of themselves but eat unhealthy food and people who are unaware of their health status because they don't have the means or because they don't want to. This can be considered a Neutro-Health-food (T,C,I,F).

Application 10: The conservation of the environment is something that has been of great interest and debate of many researchers and non-researchers. In the last decades, the concern for the conservation of the environment has undergone an amazing growth at all levels, and today it must be considered one of the most relevant matters at a scientific, doctrinal and normative level. Indeed, if less than fifty years ago the relationship between human rights and the environment was ignored, today there are numerous binding normative texts that enshrine both the right to a healthy environment and the so-called rights of environmental action, all of which is now preached as necessary to guarantee that present and future generations can develop in a healthy and beneficial environment for human life (García, 2018). But there have always been some entities that have caused a lot of damage to the environment regardless of the consequences. So, it requires neutrogeometric classification which can be characterized as follows:

I. Environment (1, 0, 0, 0): People who care for the environment and do not consume the products of companies that affect the well-being of the environment, for the given topic can be considered as relevant Environment (1, 0, 0, 0).

II. Anti-Health-food (0, 0, 0, 1): People who do not care for the environment and consume the products of companies that affect the well-being of the environment, even knowing that this can be harmful to themselves. This can be considered as Anti-environment (0, 0, 0, 1).

III. Neutro-environment (T,C,I,F): people who consume the product of said company and talk about conserving the well-being of the environment and people who are unaware of the reality of the environment because they do not read news about it or are not interested in knowing about the subject, since according to them it is not their convenience. This can be considered a Neutro-environment (T,C,I,F).

4. **Conclusions**

In this work, we presented a method to deal with NeutroGeometry of type (T,C,I,F). The analysis of this method is showed together with some applications and illustrative examples. For future works, new applications to this method can be introduced and decision-making applications can be presented for a better study and analysis of this topic.

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6. Conflicts of interest

The author declares that there is no conflict of interest.

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