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SPACE APPLICATIONS AND METHODS USING EUCLIDEAN MATHEMATICS

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INTRODUCTION AND ASSUMPTIONS

We presume the following

1. The speed of light is a constant even in n-dimensional space.
2. Some light particles in n-dimensional space travel the shortest path equivalent to a straight line in 3-dimensional space. The path maybe crooked or curved as the case maybe depending on the number of dimensions it is traversing. Obviously this has an effect on the time variable stated in the 3rd assumption.
3. The formula speed = distance/time or c=s/t is valid for n-dimensional space.
4. Time is a single dimensional invariant.
5. For the time being we assume that distances and co-ordinates can be calculated using simultaneous equations and the above three assumptions – we will illustrate the method in this article.
6. We have assumed space to be only vacuum for all dimensions and there is absence of any refractive effects on signals/light either emitted or reflected from the celestial or any objects in space. In other words the medium of space is homogenous and not heterogeneous. We will discuss heterogeneous n dimensional spaces in "Scope for further research" section.
7. We presume Spectroscopy across n dimensional spaces as a legitimate tool to verify/validate our results.

SPACE METHODS FOR SPACE APPLICATIONS

Let us assume the following; there are 'm' heavenly bodies in motion in n-dimensional space and 'k' sensors either on Earth or at a Space station monitoring these 'm' heavenly objects in n—dimensional space. Therefore (see the Paper given in Reference 1) we have the following equations –

$(D11)^2 = (x11-y11)^2 + (x21-y21)^2 + (x31-y31)^2$

$(D12)^2 = (x12-y12)^2 + (x22-y22)^2 +(x31-y32)^2$ …. …….. ………

$(Dmk)^2 = (x1m-y1k)^2 + (x2m-y2k)^2 +(x3m-y3k)^2$

Where, (x1m, x2m, x3m) are co-ordinates of the mth object in n-Dimensional Euclidean Space, (y1k, y2k, y3k) are co-ordinates of the kth sensor/transceiver either on Earth or on a satellite measuring the distance of objects in the sky/space in n-Dimensional Euclidean

Space. Here the above equations are shown for 3 dimensions; the same could be extrapolated for n-Dimensional space.

Let us presume that distances in n-Dimensional space cannot be observed using known methods such as the Parallax method etc. But we know from the Paper given in Reference 2, that -

$c = s/t = \Delta s/\Delta t$ ……………………………………………………….1)

Here s, t, Δs are unknown in n-dimensions, and c, Δt are known quantities. From above equations we can calculate $\Delta s = c\Delta t$ and $s = ct$. Substituting this in above simultaneous equations we get –

$(c \text{ x } t11)^2 = (x11-y11)^2 + (x21-y21)^2 + (x31-y31)^2$

$(c \text{ x } t12)^2 = (x12-y12)^2 + (x22-y22)^2 +(x31-y32)^2$…. …….. ………

$(c \text{ x } tmk)^2 = (x1m-y1k)^2 + (x2m-y2k)^2 +(x3m-y3k)^2$ ……………………………..2)

Where, (x1m, x2m, x3m) are co-ordinates of the m^{th} object in n-Dimensional Euclidean Space, (y1k, y2k, y3k) are co-ordinates of the k^{th} sensor/transceiver either on Earth or on a satellite measuring the distance of objects in the sky/space in n-Dimensional Euclidean Space and t11, t12…. tmk are the time taken for light or a radio signal to be transmitted from the 'm' objects to the k^{th} sensors and c is a constant (speed of light) as per our stated assumptions in the Introduction.

Now for a small displacement of the object we get the following equations -

$(c \text{ x } \{t11+\Delta t11\})^2 = (x'11-y'11)^2 + (x'21-y'21)^2 + (x'31-y'31)^2$

$(c \text{ x } \{t12+\Delta t12\})^2 = (x'12-y'12)^2 + (x'22-y'22)^2 +(x'31-y'32)^2$…. …….. ………

$(c \text{ x } \{tmk+\Delta tmk\})^2 = (x'1m-y'1k)^2 + (x'2m-y'2k)^2 +(x'3m-y'3k)^2$ …………………. 3)

From equations 2) and 3) we see that, the unknowns are the co-ordinates in both the equations and the values for time. Note please that Δtmk values are known observed values. Again from the first paper mentioned (Reference 1) we know that number of known values must be equal to number of unknown values –

Hence,

$2km = 2zk + 2zm + km$

N.B. There are 2zm + 2zk unknown co-ordinates and km unknown time values. There is 2km number of simultaneous equations. Where z is the number of n dimensions, k is the number of k sensors/transceivers and m objects in space.

Therefore,

$km = 2zk + 2zm$

Hence we can deduce from above that,

$m – 1 = 2z$ ………………….. 3)

Hence,

For 'z' or 'n' dimensional space,

E.g. if z=3, m=7 and k=42; for z=4, m=9 and k=72 etc…….

Hence for a given number of dimensions we can calculate the co-ordinates of 'm' objects in space, and their distances in terms of time (tmk). But from the second paper mentioned (Reference 2) we can deduce the values of Δs and s {using equation 1) shown below; tmk calculated from equation 2) and 3); Δtmk is an observed value}. In addition, we can calculate the co-ordinates of 'm' objects, 'k' sensors/transceivers and the distances between them.

$c = s/t = \Delta s/\Delta t$ ………………………………………………………..1)

APPLICATIONS

1. Communication in n-dimensional space can be possibly done using the n-dimensional co-ordinates, their distances and time measurements.
2. Identification of 'm' objects in n-dimensional Space can be done using above techniques. An interesting situation would be to verify using Raman spectroscopy the existence of these 'm' objects in n dimensional space.
3. Assuming a space craft is going to take a particular trajectory, space probes could be used to verify whether it will traverse n dimensional spaces or not.
4. From the observable universe (either using the naked eye and/or powerful telescopes) one can possibly chart which heavenly objects are in which n-dimensional spaces.
5. A) As the co-ordinates of heavenly objects are determinate it is possible to determine K-clusters across n-dimensional spaces. It would be worthwhile to examine the behavior of clusters having objects belonging to more than one n dimensional space especially at the boundaries. Of course clustering algorithms need to be modified to take cognizance of the fact that objects belong to more than one n dimensional space.

   B) Determines clusters in n-Dimensional spaces - useful for determining the clusters of stars/planets or galaxies bound together by the forces of gravity.
6. Can be used to determine K (K Clusters) in n-dimensional space using intra-distances of objects in space and use statistics for standard deviation (For reference on Statistical treatment the reader can refer to the paper given in Reference 3, please see the section Summary and Scope for further Research in the given paper).
7. An interesting observation would be as to how a space craft would behave in n dimensional space and as it moves from a given dimensional space to another dimensional space.

SCOPE FOR FURTHER RESEARCH

Case 1)

When the value of z or n changes from z1 to z2 (or n1 to n2), in other words the space craft or remote probe is undergoing a transition from n1 dimensional space to n2 dimensional space. In such a case the values of m and k will change resulting in different values for the co-ordinates and its (space craft or probe) distance from Earth. To circumvent this problem it is necessary to have a space station at the border of n1 and n2 dimensional space so that the correct co-ordinates, distances and space time travel is recorded and transmitted to Earth.

This will result in more accurate values for co-ordinates, distances and space time travel which could be verified by spectroscopy to validate these values especially distances and space time travel.

Case 2)

Here let us assume that the space craft or probe encounters a different medium in space in the same n dimensional space. In such a case the value of c (speed of light) changes to v (speed of light in a different medium). Using spectroscopy one could get the value of v and use it to obtain values for co-ordinates, distances and space time travel time. These calculated values could be used to verify/validate the speed of light in this medium (v) by verifying the distance traversed and validate whether calculated values are in consonance with spectroscopy results.

Case 3)

In this case let us assume that z changes as well as the medium also changes. In this case we have to follow both Case 1) and 2) for this case.

Case 4)

The above concepts would be useful in Marketing and Segmentation of commodities, products, services and experiences for economic purposes. This could possibly lead to new categories of commodities, products, services and experiences across geographical, currency, demography's and other such variables/characteristics as now it might be possible to analyze across n dimensional spaces and clusters among them.

N.B. For commodities the distinguishing variables/characteristics maybe price, safety, demand-supply equation, its EVA (economic value addition), its utility value (the reader is requested to read the paper given Reference 4 for a method of determining utility value of a machine and extrapolate for commodities) and/or its brand equity value – e.g. Basmati Lal Kila, Kellogs Cornflakes. For a product the distinguishing variables/characteristics maybe price, reliability, accuracy, safety, demand-supply equation, its EVA (economic value addition), its utility value (the reader is requested to read the paper in Reference 4 for a method of determining utility value of a machine) and/or its brand equity value – e.g. Natraj Pencil, Gillette Razor. For a service the distinguishing variables/characteristics maybe price, reliability, accuracy, safety, customer delight, demand-supply equation, its EVA (economic value addition), its utility value (the reader is requested to read the paper given in Reference 4 for a method of determining utility value of a service) and/or its brand equity value – e.g. ITC Grand Maratha, Four Seasons Hotel. For an experience the distinguishing variables/characteristics maybe price, reliability, accuracy, safety, customer delight, demand-supply equation, its EVA (economic value addition), its utility value (the reader is requested to read the paper given in Reference 4 for a method of determining utility value of an experience), its brand equity value and something intangible, a property which maybe poets or intellectuals maybe able to describe the experience and vouch for – e.g. Taj Mahal, Niagarra Falls. This is apart from the standard variables like geography, currency and demography's. This concept could be used for economic purposes for a corporation, nation or individual. It would be interesting to study the probability distributions, the variations with respect to time and obviously the distances of above variables/characteristics across n dimensional spaces, especially for economic analysis.

CONCLUSION

We know that when medium changes the velocity of light undergoes refraction given by Snell's Law which is characterized by the Refractive Index of the medium. It would be worthwhile to investigate a similar relationship or analogous relationship when light/radioactive signal traverses across n dimensional spaces. Similarly for other properties when light traverses from one medium/dimension to another medium/dimension.

Also it is my opinion that just as in 3 dimensional geometry the three co-ordinates x,y and z are related to each other by the equation –

$$r^2 = x^2 + y^2 + z^2$$

And also if we use polar co-ordinates then if we know two variables then the third variable is determinate. Similarly, I presume that in n dimensional co-ordinates if n-1 co-ordinates are known then the last co-ordinate is determinate as in polar co-ordinates.

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