Extending the Classic Conclusions in Lorentz Transformation to the Relativity with Super Space Time

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Abstract. Albert Einstein found that, for two particles coming from the same source, when the state of one changes, that of the other may change at the same time, no matter how far they are apart from each other. This superluminal quantum entanglement phenomenon totally violates both the special and general theories of relativity where nothing speed exceeds the light speed. We believe that the entanglement is caused by the twist of the inhomogeneous space in different direction, and thus this speed is the same as the space vibration speed, which is way faster than the light, and we call this angle of view as the relativity with super natural space time coordinate, where time is derived from the space, and space is in turn derived from the mass. Based on the latest observations made by astronomer, there is an evidence suggesting that our universe, in large scale, is indeed a flat body, which agrees with above inhomogeneous hypothesis. One of the mathematical frameworks of relativity is related to Lorentz transformation, in this paper, we extend it for such relativity.

Keywords: Non-Euclidean; Lorentz transformation; Mapping; Relativity

1 INTRODUCTION AND MOTIVATION

In recent years, the quantum devices, quantum communications and quantum computing draw more and more attentions. The most contradictive phenomenon observed so far is the quantum entanglement. In order to explain it in full, the current relativity theory seems to be incapable. As such, we would like to revisit the Lorentz transformation, by extending it, hope to shed some light for finding a way, for going over the limit of speed of the light. Mean while, we strive to maintain the backward compatibility, by refraining from introducing the Fractal or Geometry beyond Riemann assumption.

The Lorentz transformation is also called Lorentz-Fitzgerald transformation. It is named after the Dutch physicist Hendrik Anton Lorentz (1853-1928) and Irish physicist George Francis FitzGerald (1851-1901). It reflects the surprising relativity fact that observers moving at different velocities may measure different distances, elapsed times. Although the theory is named after two physicists, the formula belongs to an important mathematical transformation. We may get a number of interesting conclusions from it. Also, we can gain better understanding of our universe by extending or proving some of the conclusions. Based on the latest observations made by astronomer[1], where there is an evidence suggesting that our universe, in large scale, is a flat spinning body like an apple pie, rather than an expanding perfectly ball shape apple. On the other hand, researchers also find that the black hole occupies more space than we thought, through the simulations[2], these findings along with some verifications[3] motivated us to rethink about the definition of space and time itself[4]. To extend the traditional Lorentz theory to cover this new finding, let's first look at the Lorentz transformation[5]:

The mapping L_2:$\mathbb{R}^2 \to \mathbb{R}^2$ (the direct product $\mathbb{R}^2 = \mathbb{R} \times \mathbb{R} = \mathbb{R}_t \times \mathbb{R}_x$ of the time axis $\mathbb{R}_t$ and the spatial axis $\mathbb{R}_x$) into itself defined by the formulas

$$x' = \frac{x - vt}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}, \tag{1}$$

$$t' = \frac{t - \left(\frac{v}{c^2}\right) x}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}, \tag{2}$$

is the transformation for transition from one inertial coordinate system (x, t) to another system (x', t') that is in motion relative to the first at speed v. c is the speed of light. Here Lorentz and Albert Einstein (1879-1955) assumed that the space (and time) is homogeneous in every direction, so the space x can be used to represent y and z, the mapping L_2 is sufficient. Unfortunately, the new finding has suggested that our universe is not a ball, but a flat pie, if we use x and z to describe the flat plane of the pie, and y to describe the axis of the pie, as such x may be still used to represent z, but not y any more. Vice versa, we now have to use L_4 mapping, to distinguish the inhomogeneous difference of space and the time on different direction as defined below.

Definition I - Super Time and Space. For a spinning mass of any size, there are two sets of space and time associated with it, x is used to denote the space measure in the spinning surface, t is the time measure in the space x. y is used to denote the space measure in the space that is perpendicular to the spinning surface, k is the time measure in the space y.

The new mapping L_4:$\mathbb{R}^4 \to \mathbb{R}^4$ (the direct product $\mathbb{R}^4 = \mathbb{R}_t \times \mathbb{R}_k \times \mathbb{R}_x \times \mathbb{R}_y$ of the time axis $[\mathbb{R}_t, \mathbb{R}_k]$ and the spatial axis $[\mathbb{R}_x, \mathbb{R}_y]$) into itself defined by the formulas

$$[x, y]' = \frac{[x, y] - [v, u].*[t, k]}{\sqrt{1 - \frac{[v,u].*[v,u]}{[c,b].*[c,b]}}}, \tag{3}$$

$$[t, k]' = \frac{[t, k] - \left[\frac{[v,u]}{[c,b].*[c,b]}\right].*[x, y]}{\sqrt{1 - \frac{[v,u].*[v,u]}{[c,b].*[c,b]}}}, \tag{4}$$

is the transformation for transition from one inertial coordinate system (x, y, t, k) to another system (x', y', t', k') that is in motion relative to the first at speed v and u in a non-Euclidean time space. c is the speed of light, b is the basic speed of quantum entanglement[6] speed, that is faster[7] than c. The local subspaces (x, t) and (y, k), which are still Euclidean, of the non-Euclidean total global time space (x, y, t, k), are relatively independent with each other.

Note that all the operations used here are quite different from the traditional arithmetical operations. In the sense that it is elemental oriented, it is neither dot product, nor cross product, it is element-wise defined by:

$$[a, b]. + [c, d] = [a + b, c + d] \tag{5}$$

$$[a, b]. - [c, d] = [a - b, c - d] \tag{6}$$

$$[a, b]. * [c, d] = [ab, cd] \tag{7}$$

$$[a, b]./[c, d] = [a/b, c/d] \tag{8}$$

The operation is used in Matlab[8]. The same concept can be extended to other operations if necessary. And these element-wise operations in formulae (3) and (4) are backward compatible with scale operations in formulae (1) and (2), however, it allows us to address times and spaces for different directions, in large scale physical viewing of our universe, as well as the quantum viewing of non-homogeneous setting[9]. Note that the full Lorentz transformation is 4-dimensional[10], to simplify the derivation here, we focus on the original 2-dimensional case[11], just to illustrate the new concept. What worth's mention is that some Fractal related anisotropic[12] mathematical model was reported with regards to particles that are faster than speed of light[13]. And even newer geometry [14] have dropped the quadratic limitation which is the corner stone of general relativity completely.

2 EXTENDING SOME IMPORTANT CONCLUSIONS

From the above formulas, we can get some interesting conclusions in mathematics.

Theorem A - Relativity. A mapping L_n is a bijection if and only if L_n exists an invertible mapping.

Conclusion 1 - Simplicity. The *inverting transformation* of the Lorentz transformation is only change two operators. The form of the inverting transformation is:

$$x = \frac{x' + vt'}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \tag{9}$$

$$t = \frac{t' + \left(\frac{v}{c^2}\right) x'}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \tag{10}$$

Proof. From equation (1) and (2),we can infer the matrix of Lorentz transformation is

$$A = \frac{1}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \begin{pmatrix} 1 & -v \\ -\frac{v}{c^2} & 1 \end{pmatrix}. \tag{11}$$

so, the Lorentz transformation can be turned into the form

$$\begin{pmatrix} x' \\ t' \end{pmatrix} = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \begin{pmatrix} 1 & -v \\ -\dfrac{v}{c^2} & 1 \end{pmatrix} \cdot \begin{pmatrix} x \\ t \end{pmatrix}, \tag{12}$$

because we want to know the inverting transformation of the Lorentz transformation, we just solve the matrix equation

$$\begin{pmatrix} x \\ t \end{pmatrix} = X \begin{pmatrix} x' \\ t' \end{pmatrix} \tag{13}$$

Then, multiplying both sides of equation (12) on the left by matrix A^{-1}, we can get

$$X = A^{-1} = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \begin{pmatrix} 1 & v \\ \dfrac{v}{c^2} & 1 \end{pmatrix} \tag{14}$$

Thus, the inverting transformation of the Lorentz transformation is only change of two operators. □

Conclusion 2 - Duplicity. The *inverting transformation* of the Extended Lorentz transformation is only change of four operators. The form of the inverting transformation is:

$$[x, y] = \frac{[x, y]' + [v, u].*[t, k]'}{\sqrt{1 - \frac{[v,u].*[v,u]}{[c,b].*[c,b]}}} \tag{15}$$

$$[t, k] = \frac{[t, k]' + \frac{[v,u]}{[[c,b].*[c,b]]}.*[x, y]'}{\sqrt{1 - \frac{[v,u].*[v,u]}{[c,b].*[c,b]}}} \tag{16}$$

Proof. From equation (3) and (4),we can infer the matrix of Extended Lorentz transformation is

$$B = \begin{pmatrix} \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{-v}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{-u}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \\ -\frac{v/c^2}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & -\frac{u/b^2}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \end{pmatrix}. \tag{17}$$

so, the Extended Lorentz transformation can be turned into the form

$$\begin{pmatrix} x' \\ y' \\ t' \\ k' \end{pmatrix} = \begin{pmatrix} \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{-v}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{-u}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \\ -\frac{v/c^2}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & -\frac{u/b^2}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \end{pmatrix} \begin{pmatrix} x \\ y \\ t \\ k \end{pmatrix}, \tag{18}$$

Because we want to know the inverting transformation of the Extended Lorentz transformation, we just solve the matrix equation

$$\begin{pmatrix} x \\ y \\ t \\ k \end{pmatrix} = Y \begin{pmatrix} x' \\ y' \\ t' \\ k' \end{pmatrix} \tag{19}$$

Because

$$\begin{pmatrix} \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{-v}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{-u}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \\ -\frac{v/c^2}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & -\frac{u/b^2}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \end{pmatrix} \begin{pmatrix} \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{v}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{u}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \\ \frac{v/c^2}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & \frac{u/b^2}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}, \tag{20}$$

we can get

$$Y = B^{-1} = \begin{pmatrix} \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{v}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{u}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \\ \frac{v/c^2}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} & 0 \\ 0 & \frac{u/b^2}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} & 0 & \frac{1}{\sqrt{1-\left(\frac{u^2}{b^2}\right)}} \end{pmatrix} \tag{21}$$

Thus, the inverting transformation of the Extended Lorentz transformation is only change of four operators. □

Conclusion 3 - Homogeneous Relativity. The Lorentz transformation is a *Bijection.*

Proof. From Conclusion 1, we know that the Lorentz transformation exists inverting transformation. That is to say mapping L_2 exists an invertible mapping that can be expressed as

$$x' = \frac{x + vt}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \tag{22}$$

$$t' = \frac{t + \left(\frac{v}{c^2}\right) x}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \tag{23}$$

According to Theorem A, we can easily know that the Lorentz transformation is a bijection. □

Remark 1 - Newton System. This conclusion is very useful in mathematics, because Lorentz transformation is a bijection, traditional Galileo transformation is a bijection of course, which will be shown later on. The proof of this conclusion provided us a convenient way of using Theorem A of relativity, it is an important Theorem, however, it is not contained in many *Algebra* books, without the concept of such mapping, to prove that some classic transformations are bijection becomes troublesome.

Conclusion 4 - Inhomogeneous Relativity. The Extended Lorentz transformation is also a *Bijection.*

Proof. From Conclusion 2, we know that the Extended Lorentz transformation exists inverting transformation. That is to say mapping L_4 exists an invertible mapping that can be expressed as

$$x' = \frac{x + vt}{\sqrt{1 - \left(\frac{v^2}{c^2}\right)}} \tag{24}$$

$$y' = \frac{y + uk}{\sqrt{1 - \left(\frac{u^2}{b^2}\right)}} \tag{25}$$

$$t' = \frac{t + \left(\frac{v}{c^2}\right) x}{\sqrt{1 - \left(\frac{v^2}{c^2}\right)^2}} \tag{26}$$

$$k' = \frac{k + \left(\frac{u}{b^2}\right) x}{\sqrt{1 - \left(\frac{u^2}{b^2}\right)^2}} \tag{27}$$

According to Theorem A, we can easily know that the Extended Lorentz transformation is a bijection. □

Remark 2 - Einstein System. This conclusion is very useful in mathematics, because Extended Lorentz transformation is a bijection, when y=k=u=b=0, the Extended Lorentz degenerated back to the original Lorentz construction.

Conclusion 5 - Super Minkowski Composition. For three consecutive super natural relative systems with vector speed in vector time over vector space on top of each other, the $\circ$ *operation* follows the formula

$$L_U \circ L_V = L_W \tag{28}$$

$$W = \frac{U+V}{1+\frac{(U*V)}{C*C}} \tag{29}$$

Proof. By using matrix, L_U, L_V, L_W can be expressed by the form below:

$$L_U: \quad \left(X''\right) = \left(D_u\right)\left(X'\right) \tag{30}$$

$$L_V: \quad \left(X'\right) = \left(D_v\right)\left(X\right) \tag{31}$$

$$L_W: \quad \left(X''\right) = \left(D_w\right)\left(X\right) \tag{32}$$

So,

$$\left(D_w\right) = \left(D_u\right)\left(D_v\right) \tag{33}$$

therefore,

$$W = \frac{U+V}{1+\dfrac{(U*V)}{C*C}} \tag{34}$$

□

Conclusion 6 - Galileo Kepler. When $\frac{v}{c} \to 0$, the Lorentz transformation becomes

$$x' = x - vt \tag{35}$$

$$t' = t \tag{36}$$

This transformation is called *Galileo transformation.* We know that all the physical laws exist under Lorentz transformation, however, Newtonian mechanics can only hold under Galileo transformation. So, we can easily infer that Newtonian mechanics is only a special case of Einstein's relativity theory when $\frac{v}{c} \to 0$. And in addition, the Einstein's relativity is only a special case of our Super Natural relativity, when $\frac{u}{b} \to 0$. The experiments[15] conducted by physicists and astronomers have shown that quantum entanglement[16] speed b is four magnitude higher than speed of light c.

3 SUMMARY AND CONCLUSION

All the functions can be considered as mappings on different dimensions with vectors[17], when we deal with functions, we can use the knowledge of the mapping, such as bijection - one of the cornerstones for relativity. Secondary, matrix is a widely used engineering tool and it is one of the most important concept in mathematics. Using matrix can simplify many complex problems, therefore, when we meet some problems that is contradictive like quantum entanglement, choose matrix to solve the dilemma could be a quick exit. Thirdly, mathematics comes from all the sciences, in return, it serves back all the science field at the same time. In this paper, we defined element-wise operators, and by using the new operators, extended Lorentz transformation, hope to lay a foundation for super natural relativity theory, which can be used to design a quantum communications[18] network[19] sooner or later.

There are a few immediate applications of the results obtained here. The radiation pattern of a radio changes considerably when it is placed in a high speed spinning disk consists of combination of ceramic and metal layers[20], which suggests that the space time gets distorted. Maxwell equations no longer hold accurately. The quantum entanglement devices are also affected by the cavity relative orientation[21]. Worst come to worst, by introducing the new clock associated with the new location ruler, we are able to enhance the encryption algorithm for secured[22] communications.

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