Relativity Theory and Lorentz's Transformation And Application in the spacetime

By Ahmed .S. Arief

Faculty of science mathematics and physics theoretical

Abstract

This paper show the how can derivative the LT in space time and how is the important to study the RT to explain the surface and gravity in the GR in this paper can show the case to describe the electromagnetic and the property of LT simple derivate to LT give by partial differential in 2-case where make the transformation S to S' can write $X=X(x', t')$ and where transformation S' to S can write $X'=X'(x, t)$ and by the function can show the

$$\frac{dX}{dt}=\left(\frac{\partial X}{\partial x'}\frac{dx'}{dt'}+\frac{\partial X}{\partial t'}\right)*\frac{dt'}{dt}$$

The similar X' and by Einstein

The speed of light (in a vacuum) is the same in all inertial frames of reference, regardless of the motion of the light source.

Can find the LT give by:

The constant δ is consist of c speed of light and v

$$\delta = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$$

The last equations make the revolution in the electromagnetic and the bodies move by high speed near the speed of light Brief of Gillian transformation can't describe the speed and the Maxwell equation if we bout the last equation in the (GT) can be find good result the wave equation can be write

$$\nabla^2\psi(x,t)-\frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2}=0$$

Now we think if we want the GT the last equation its fair by the LT can take good result the Lorentz's transformation give by where S' to S

$$X = \frac{x' + vt}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The times give by

$$t = \frac{t' + \frac{v x'}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Can I explain some important properties LT .

We can prove:

$$c^2 t^2 - x^2 = c^2 t'^2 - x'^2$$

For any relative coordinated system using one them:

$$c^2 t_n^2 - x_n^2 = k$$

By electromagnetic waves:

$$\omega = \frac{x_n}{t_n}, \upsilon = \frac{1}{t_n}$$

But what happen to LT under the Maxwell's equation?

The LT keep the Maxwell's equation in all inertial frame, showing in the process the equivalence of all inertial frames. Since Einstein treatment of special relative theory (SRT) is based on a discussion of space and time, since any velocity including that of light is by derivative from distance and time SRT suffers three major flaws :

1- Interpreting the invariance of light speed by using LT
2- Length contraction as kinematics effect
3- Time dilation as kinematics effect

The relativity principle requires that the law be exactly the same as that found in S

The relativity principle may be used in different ways. If we think we know a law of nature which connects various observed quantities, we can use the relativity principle to find out how the observed quantities must transform.

Historically, electromagnetic theory preceded special relativity theory as is attested by the fact that Einstein's great 1905 paper bore the title "on the electrodynamics of moving bodies".

COULOMB'S LAW

The experiments of coulomb and other established that the force which a stationary charge q_2 is directly proportional to the magnitudes of the charge s inversely proportional to square of the distance between them , we can we write this follows :

$$F = k\frac{q_1 q_2}{r^2} e_r$$

Since e_r is equal to r/r, where r is the vector distance from q_1,q_2 coulomb's law can also be written:

$$F = kq_1 q_2 \frac{r}{r^3}$$

Since F is proportional to the magnitude of the test charge, and independent of its velocity we can use our knowledge of force F_{elec} for given value of q_2 to define what we call the electric filed E at the position of the test charge:

$$F_{elec} = q_2 E$$

And so for a case of stationary source charge q_1 we have

$$E = \frac{kq_1}{r^2} e_r$$

Given the value of E , we can then calculate the coulomb force on any charged partial at a given position

The magnetic force on charge is moving :

The field has a well defined direction, as indicated for example by compass needle, and the magnetic force on the moving charge is found to be given by the following equation:

$$F_{mag} = cons(q_2 v x B)$$

Where v is the velocity of the charged particle and B characterizes the strength and direction of the magnetic field in the CGS system the constant of 1/cthe defined unite of magnetic field , the basic law of force on a moving charge can then be written in MKS system :

$$F_{mag} = (q_2 v x B)$$

Given the value of B at a point, we can then calculate the magnetic force on any charged practical, with any velocity, at that point.
The total electromagnetic force on a charge at a give point can them write:

$$F = q(E + v \times B)$$

We shall begin with some situation in which the test charge is stationary with respect to a reference frame S

1- Transformation the frame S with source charge
2- Transform back from S' to S, so as to statement of the force
The TL of space time by coordination (x, t) and (x', t'):

$$x' = \frac{x - vt}{\sqrt{1 - \frac{c^2}{v^2}}} \ldots\ldots\ldots\ldots\ldots x = \frac{x' + vt'}{\sqrt{1 - \frac{c^2}{v^2}}}$$

$$t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1 - \frac{c^2}{v^2}}} \ldots\ldots\ldots\ldots\ldots t = \frac{t' + \frac{vx'}{c^2}}{\sqrt{1 - \frac{c^2}{v^2}}}$$

Now we can study the force on a stationary test charge:

I will show 3-case and very important case for the force:

Case (1) . The source charge q_1 be moving with the constant velocity (v, 0, 0) relativity to s and, the time t=0, be located instantaneously at the origin of S the charge in x-axis (x, 0, 0)
Space time coordination q_1: (0, 0, 0, 0).
Space time coordination q_2: (x', 0, 0, t').
Now we can describe the force the charge in S' by the coordination Coulomb's law:

$$F_{x'} = \frac{kq_1q_1}{x'^2}$$

By the space time coordination LT in SR we can find the source charge where t=0 can find the $x' = \delta x$ and $t' = \delta (vx/c^2)$
We can write the last law in F_x :

$$F_x = \frac{1}{1-\frac{v^2}{c^2}} \frac{kq_1q_2}{x^2}$$

Case (2). After to study case 2 we can find the force transformation

$$F_{x'} = \frac{F_x - (v/c^2)(F \odot u)}{1 - vu_x/c^2} \text{.......} F_x = \frac{F_{x'} + (v/c^2)(F \odot u)}{1 + vu_x/c^2}$$

$$F_{y'} = \frac{F_y/\delta}{1 - vu_x/c^2} \text{.......} F_y = \frac{F_{y'}/\delta}{1 + vu_{x'}/c^2}$$

We have to choice for derivative the force :

1- by the p=mv
2- by the electromagnetic we can see that after that by electromagnetic

Now, let study the second case. Consider now second situation in which the test charge q_2 is stationary on y axis at the point (0,y,0)

let the source charge be moving with the constant velocity (v,0,0) relative to S and the time t=0
In S' the space time coordination of q_2 with the velocity $u_{x'}$=-v
When the q_2 is located at the S':

$$F_{y'} = \frac{kq_1q_2}{y'^2}$$

But by the force derivative in F_y where u_x=-v we find

$$F_y = \delta F_{y'}$$

In this case, therefore, the force on q_2 is different as measured in the two system, Expressing F_y in terms of the separation of charges as measured in S, we have:

$$F_{y'} = \delta \frac{kq_1q_2}{y'^2}$$

Case (3). This case is the result of case 1 and 2 we can get in the coordination (x, y, z, t) we can write Coulomb's law:

$$F_{x'} = kq_1q_2\frac{x'}{r'^3} \qquad F_{y'} = kq_1q_2\frac{y'}{r'^3} \qquad F_{z'} = kq_1q_2\frac{z'}{r'^3}$$

By case 1 and 2

$$F_x = F_{x'} \qquad F_y = \delta F_{y'} \qquad F_z = \delta F_{z'}$$

Thus

$$F_{x'} = kq_1q_2\frac{x'}{r'^3} \qquad F_{y'} = \delta kq_1q_2\frac{y'}{r'^3} \qquad F_{z'} = \delta kq_1q_2\frac{z'}{r'^3}$$

And we can write last by the

$$F = \delta kq_1q_2\frac{r}{r'^3} = kq_1q_2\frac{\delta r}{(\delta^2x^2+y^2+z^2)^{3/2}}$$

Describe the force exerted on a stationary test charge the value of F/q_2 is just the electric field E we have:

$$E(x,y,z) = \delta kq_1\frac{r}{r'^3} = kq_1\frac{\delta r}{(\delta^2x^2+y^2+z^2)^{3/2}}$$