An Alternative Approach to Lorentz-Fitzgerald Equations

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Abstract : Here I have tried to provide an alternative approach to Lorentz-Fitzgerald equation. I have considered the speed of light as relative and not absolute, but very essential in measuring the time and distance units of two different frames moving with relative velocity v. I have also shown why the size of the moon varies according to the longitude and the time of the night.

Introduction :

Lorentz contraction factor

In the start of the 19^{th} century michaelson-morleys did an experiment to conclude that speed of light is not affected by the luminiferous ether, either moving along with it , or against it. Considering this experiment Lorentz and Fitzgerald came up with the contraction factor 'α' . It was a length contraction and time dilation factor. This factor should exist if luminiferous ether is present in the atmosphere and does not provide a drag.

One way of interpreting the experiment would be that there is no luminiferous ether present at all, hence no ether drag. Then there is no need of Lorentz- Fitzgerald contraction factor. Albert Einstein concluded the same i.e there is no luminiferous ether. but retained the contraction factor 'α' as it is.

Albert Einstein's way of thinking was speed of light is the same for an observer moving towards it or away from it , hence there is no relativistic addition . Albert Einstein completely ignored the apparent-fixed value of speed of light because of the periodic motion associated with it (Ref: research paper - "Speed of light is relative and not absolute").

But one way of looking at it would be to say that the speed to light does not get affected by the velocity of source of its production. Hence it remains absolutely constant. But absolutely constant w.r.t what? This is a major question. Either it can give an absolute rest frame, or we can assume that all 'constant velocities' or 'equilibrium frames' are rest frame of references.

The original factor of length contraction and time dilation is given as.

$\alpha = 1 / \sqrt{(1 - v^2/c^2)}$

We can derive the same factor by considering the alternative derivation of the Lorentz- Fitzgerald equation.

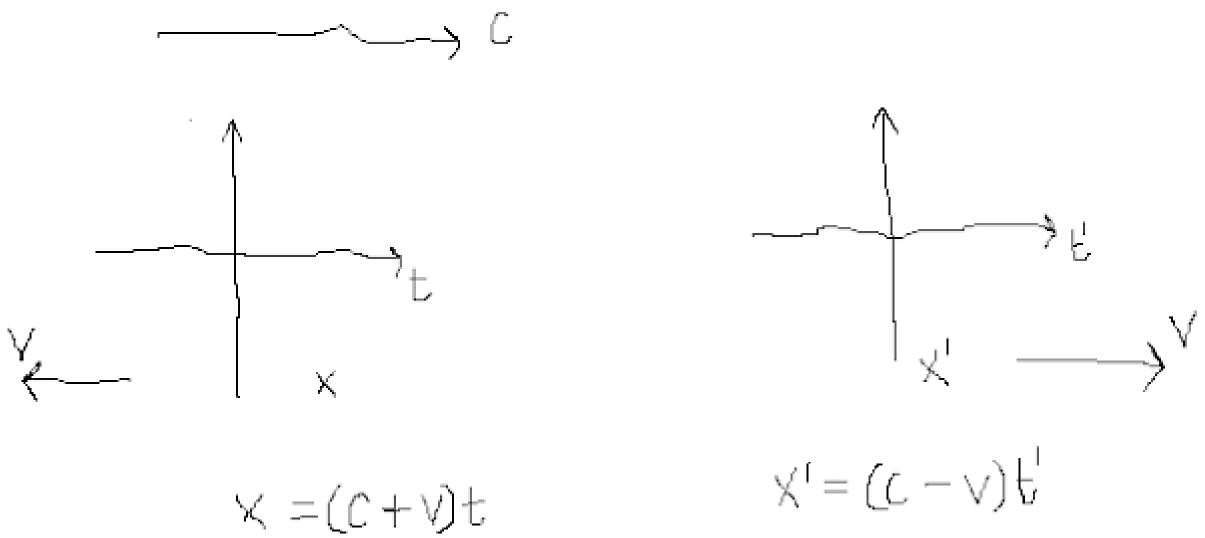

Fig 7

I have already proved that speed of light follows vector addition (ref: Research Paper – "Speed of light is relative and not absolute".

Now consider the following scenario , a man is standing on the road but mounted on a skateboard in a dark lonely night. A motorcyclist passes by him at speed of 'V' . He also has no head lights or tail lights. A lamp further apart is illuminating the man as well as the motorcyclist. The man on the skateboard is facing the motorcyclist with his back turned towards the lamp. The motorcyclist as well as the man are able to see each other because of the illumination of the lamp.

In the above diagram , let X be the frame of reference of the man , and X' be the frame of reference of the motorcyclist.

Looking towards the motorcyclist, the man will himself feel that he is moving towards the left by velocity V. Considering speed of light as being relative and not absolute, and here there being no fixed frame of reference , the man concludes that speed of light that he receives is c + v. Similarly the motorcyclist will conclude that the speed of light is c – v , and because of this change in speed where will be a perceived increase and decrease in frequency and because of doppler effect there will be a perceived differences in time and distance units of the two frames.

$x = (c + v)\, t$
$x' = (c - v)\, t'$

Again coming back to the Lorentz factor

$X - vt = \alpha (x')$
$X' + vt' = \alpha(x)$

$(C+ v)t - vt = \alpha(c-v)t'$
$(c - v)t' + vt' = \alpha(c + v)t$

$Ct = \alpha(c-v)t'$
$Ct' = \alpha(c+v)t$

Multiplying the two we still get the same value for the contraction factor

$$\alpha = 1/ \sqrt{1 - \frac{v2}{c^2}}$$

Which come out to be the same as Lorentz dilation factor. Again length will be contracted and time will be dilated.

Size of the moon along the longitude of earth

Consider the case of rotational motion of the earth around itself with the moon considered as fixed. Earth is rotating around itself at velocity ‘v’.

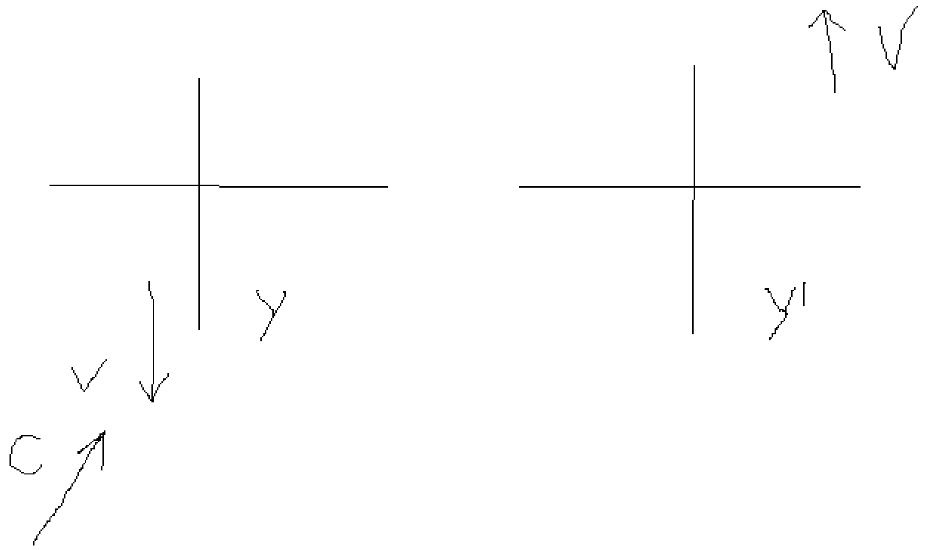

Fig 8

Here frame y is considered that of earth and y’ that of the moon. Since the earth is moving down by velocity ‘v’, and from the perspective of the moon it is going up by velocity ‘v’.

Light is received from the sun obliquely at velocity ‘c’ . The two frames will calibrate their respective distance units by vector addition as,

$y = (\sqrt{c^2 + v^2 + 2cv \cos\theta})t$ and $y' = (\sqrt{c^2 + v^2 - 2cv \cos\theta})t'$

For $\theta = 0$ i.e ‘C’ parallel to ‘V’ . We get

$y = (c + v)t$ and $y' = (c - v)t'$

Substituting in the Lorentz-Fitzgerald equation.

$y - vt = \alpha (y')$
$y' + vt' = \alpha (y)$

Substituting the values we derive the same contraction factor as

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

As the velocity ‘v’ increases the length will contract by the inverse factor $1/\alpha$.
As we know earth rotates along its vertical axis . So the velocity of rotation ‘v’ will be different along the longitude of earth. It will be basically be the lowest at the poles and largest at the equator. Hence a man observing the moon from different places on earth will see varying sizes of moon, with its size largest at the poles and smallest at the equator.

Moon Over the top Vs the horizon

For Moon over the top:

For the moon over the head position equations will be the same as circular motion which finally boils down to the above contraction factor

$$\alpha = 1/ \sqrt{1 - \frac{v^2}{c^2}} \quad \text{--------------------------} \quad 1$$

So here the length will contract by factor $1/\alpha$.

For Moon Over the Horizon :

Now for moon over the horizon consider the following diagram

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Moon over the Horizon

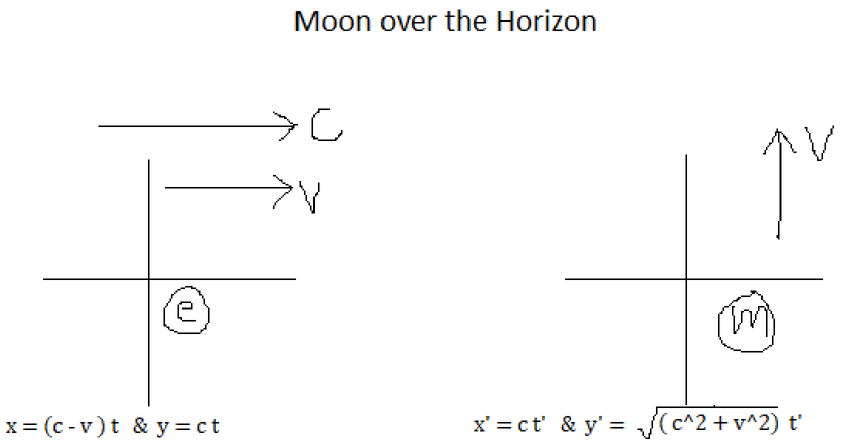

Fig 9

Consider that the earth is rotating on its axis towards the moon by velocity v_1, and moon is going up by a velocity v_2 . For simplicity sake consider $v_1 = v_2 = v$

From the earths perspective since the moon is going up , it will feel that it itself is moving down by velocity 'v'.
From the moons perspective , since earth is moving towards it, it itself would feel that it is moving towards earth by velocity 'v'

Lets arrive at the two equations

$y - vt = \alpha (y')$ ---------------- 2
$x' - vt' = \alpha(x)$ ---------------- 3

$ct - vt = \alpha \sqrt{(c^2 + v^2)}\, t'$ ---------- 4
$ct' - vt' = \alpha (c - v)t$ ---------- 5

from equation 5 we get,

$t'/t = \alpha$

Substituting the value of t'/t in equation 4 , we get

$\alpha^2 = (c - v) / \sqrt{(c^2 + v^2)}$
Or,
$\alpha = \sqrt{ (c - v) / \sqrt{(c^2 + v^2)} }$ ---------------------- 6

This is the contraction factor , hence the length will dilate by factor 1/ α.

Hence Over the horizon the moon will appear dilated. This is possible only if we consider vector addition of light velocity c with that of v. So usually you will see that the moon appears bigger over the horizon and it becomes smaller and smaller as it moves overhead.

Conclusion : The alternative derivation of Lorentz-Fitzgerald equation assumes that the speed of light is not absolute. We can maintain the same contraction factor by this assumption. I have provided an explanation on why the moon appears largest at poles and over the horizon but smaller at the equator and also overhead. This is possible only by the alternative explanation as it allows for vector addition.