Velocity Transformation in Reference Frame

Eric Su
eric.su.mobile@gmail.com
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A moving object in one inertial reference frame always moves at a different speed in another inertial reference frame. To determine this different speed, a temporary acceleration is applied to a duplicate of the first inertial reference frame in order to match the second inertial reference frame. The velocity transformation between two inertial reference frames is precisely derived based on the applied acceleration. The result shows that velocity transformation depends solely on the relative motion between inertial reference frames. Velocity transformation is independent of the speed of light.

I. INTRODUCTION

A moving object in one inertial reference frame will move at a new speed in another inertial reference frame. The new speed clearly depends on the relative motion between two inertial reference frames. It is not clear what other factors also account for this new speed. Lorentz Transformation[1][2] claims that the new speed also depends on the speed of light.

In this paper, the acceleration is used to transform one inertial reference frame to another inertial reference frame. The velocity transformation that relates the speeds of the same object in both inertial reference frames will be precisely derived.

II. PROOF

Consider one-dimensional motion

A. Relative Motion

Let an inertial reference frame F_2 move at a speed of V relative to another inertial reference frame F_1. Let a clock W_1 be stationary in F_1. Let a clock W_2 be stationary in F_2.

The speed of W_1 in F_1 is 0
The speed of W_2 in F_2 is 0

These two clocks, W_1 and W_2, are in relative motion to each other in F_1.

The speed of W_1 in F_1 is 0
The speed of W_2 in F_1 is V

Let a reference frame F_3 be stationary relative to F_1. Therefore,

The speed of W_1 in F_3 is 0
The speed of W_2 in F_3 is V

B. Acceleration

Put F_3 under a constant acceleration A relative to F_1 for a duration T. For the relative motion between F_1 and F_3, this is equivalent to putting F_1 under a constant acceleration -A relative to F_3 for a duration T.

By the definition of acceleration, this temporary acceleration produces a difference in the relative speed between F_1 and F_3 and accelerates all clocks in F_1 by -A*T in F_3.

The speed of F_1 relative to F_3 is V_{13}

$$V_{13} = -A * T \tag{1}$$

The speed of W_1 in F_3 is 0 + V_{13}
The speed of W_2 in F_3 is V + V_{13}
The speed of W_1 in F_1 is 0
The speed of W_2 in F_1 is V

Therefore, a moving clock in F_1 will move in F_3 at a speed equal to the sum of its speed in F_1 and the relative speed between F_1 and F_3. This is the velocity transformation from F_1 to F_3.

If v is the speed of a clock in F_1 and v' is the speed of this clock in F_3 then the velocity transformation between F_1 and F_3 follows this equation

$$v' = v + V_{13} \tag{2}$$

III. CONCLUSION

The velocity transformation between two inertial reference frames exclusively depends on the relative speed between two inertial reference frames. It is independent of the speed of light.

For more than a century, there have been speculation that the speed of light is a factor in velocity transformation. This is clearly incorrect as in the proof of this paper.

Therefore, any proposed velocity transformation that incorporates the speed of light is invalid in physics. One particular example is Lorentz Transformation[1][2] which is based on the assumption that the speed of light is independent of inertial reference frame.

As a result of its incorrect assumption[3], Lorentz Transformation violates Translation Symmetry[4] in physics. Translation Symmetry requires conservation of simultaneity[5], conservation of distance[6], and conservation of time[7]. All three conservations are broken by

Lorentz Transformation. Therefore, Lorentz Transformation is not a proper transformation in physics.

Consequently, any theory based on Lorentz Transformation is incorrect in physics. For example, Special Relativity[4][8]

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