Translational Symmetry and FitzGerald-Lorentz Contraction

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Translational symmetry in one-dimensional space requires the distance between two objects moving at equal speed under equal acceleration to be constant in time. However, motion between the object and the observer is relative. Therefore, this distance is constant in time for an accelerating observer. Consequently, the length of an accelerating object is constant in time. The length of an moving object in the direction of motion is independent of its speed.

I. INTRODUCTION

FitzGerald-Lorentz Contraction is a hypothesis proposed by George FitzGerald in 1889[1] and Hendrik Lorentz in 1892[2] in an attempt to explain the null result of the Michelson-Morley experiment in 1887[3]. This hypothesis claims that a moving body will contract more in the direction of motion if it moves faster.

During 1899-1904[4], Hendrik Lorentz proposed Lorentz Transformation which asserts that the distance between two locations in a moving reference frame will become shorter in a stationary reference frame if the speed of this reference frame is greater.

In this paper, translational symmetry will be the fundamental concept of a rigorous examination on both FitzGerald-Lorentz Contraction and Lorentz Transformation.

II. PROOF

Consider one-dimensional motion.

A. Conservation of Distance

An object moving at a constant speed will move a certain distance over certain time. According to Translational Symmetry, such displacement is independent of the starting location of this object. Two such objects of equal speed at different starting locations will move an equal distance over the same duration. Therefore, the distance between these two objects is constant in time and is equal to the distance between their starting locations.

Put both objects under identical acceleration at the same time. Both will move an equal distance over the same duration. Therefore, the distance between these two objects is still constant in time while both objects accelerate.

Proof 1. **To an observer at rest, the distance between these two objects is invariant as long as both objects move at the same speed.**

B. Reference Frame

Consider two reference frames in motion relative to each other. Place this pair of objects at rest in one reference frame F1. Place the observer at rest in another reference frame F2. Put F1 under acceleration relative to F2.

Proof 2. **As stated in *Proof 1*, the distance between two objects in F2 is constant in time to the observer in F2 and independent of the relative speed between F1 and F2.**

C. Relative Motion

In one-dimensional space, motion between the object and the observer is relative.

Let a rod be stationary in reference frame F1. Let an observer be stationary in reference frame F2. Put F2 under acceleration relative to F1. Accordingly, F1 accelerates relatively to F2. The distance between both ends of this rod in F2 is constant in time as stated in *Proof 2*.

Proof 3. **Therefore, the length of a moving object in the direction of motion is independent of its speed.**

III. CONCLUSION

In one-dimensional space, Translational Symmetry leads to conservation of distance. The distance between two locations in a reference frame is invariant to the observer in another reference frame. This distance is independent of the relative speed between two reference frames. Consequently, the length of an object is independent of its motion.

This contradicts the hypothesis of FitzGerald-Lorentz Contraction. Therefore, FitzGerald-Lorentz Contraction is invalid for one-dimensional motion. Consequently, Lorentz Transformation violates Translational Symmetry in one-dimensional motion.

For more than a century, many physicists have been under the wrong impression that a moving body should contract in the direction of its motion. This paper provides a rigorous proof that such belief is absolutely false.

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