Scaling and Distance of the Frame of Reference for Lorentz Transformation of Special Relativity Theory

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Abstract

Lorentz transformation handles oblique frames of reference. Regarding to the oblique frame of reference system, investigation about scaling and distance is required for clear understanding how the Lorentz transformation can be derived.

1. Introduction

There is a report to derive Lorentz transformation from basic assumption. [1] In the process, moving system becomes an oblique system on orthogonal system. To complete the process, investigation of scaling of each dimensions and definition of distance for the system is required.

2. Distance of oblique system

Regarding to the Lorentz transformation, frame of reference of moving system is oblique system as Fig.1. [1]

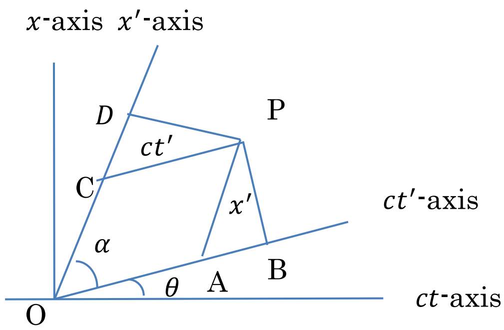

Fig. 1

x of point P is distance from ct-axis or ct value constant line's length from 0 to x.

This is the case of orthogonal system.

But in the case of oblique system, shortest distance from ct'-axis($\overline{\mathrm{PB}}$) is different from ct' value constant line's length from 0 to x'($\overline{\mathrm{PA}}$).

Here x' value of oblique system also should be distance of x' dimension. So it should not include ct' dimension element. Then x' value of oblique system should be $\overline{\mathrm{PA}}$ not $\overline{\mathrm{PB}}$.

On similar reason, actual elapse time (ct') of P should be $\overline{\mathrm{CP}}$ not $\overline{\mathrm{DP}}$.

Then

$$ct' = \overline{\mathrm{OA}} = \frac{\overline{\mathrm{DP}}}{\sin\alpha} = \frac{ct\cos\theta - x\sin\theta}{\sin\alpha} \tag{1}$$

$$x' = \overline{\mathrm{OC}} = \frac{\overline{\mathrm{PB}}}{\sin\alpha} = \frac{-ct\sin\theta + x\cos\theta}{\sin\alpha} \tag{2}$$

3. Experience

When time t passes for space volume V (length l in the case of two dimensions, space and time), integration of V from time 0 to t is defined as experience(exp). This is

$\exp = \int_0^t V dt$

Ten thousand years on Sun is something different from 10 μ s for an atom.

Experience is *that* something and its value indicate the huge difference in this case.

4. Scaling

In the case of orthogonal system, (Fig.2),

$$exp = l \times t \tag{3}$$

In the case of oblique system, (Fig.3),

$$exp = l \times t\sin\alpha = l\sqrt{\sin\alpha} \times t\sqrt{\sin\alpha} \tag{4}$$

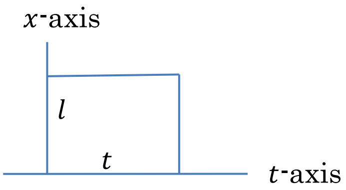

Fig. 2

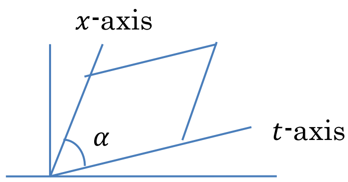

Fig. 3

Comparing (3) (4), distance value of oblique system is multiple $\sqrt{\sin\alpha}$ of orthogonal system's value.

This $\sqrt{\sin\alpha}$ is scaling factor for oblique system (in the case of orthogonal system, $\sqrt{\sin\alpha} = 1$).

5. Conclusion

Considering above investigation of scaling and distance, (1) (2) become

$$ct' = \overline{\mathrm{OA}}\sqrt{\sin\alpha} = \frac{ct\cos\theta - x\sin\theta}{\sin\alpha}\sqrt{\sin\alpha} = \frac{ct\cos\theta - x\sin\theta}{\sqrt{\sin\alpha}} \tag{5}$$

$$x' = \overline{\mathrm{OC}}\sqrt{\sin\alpha} = \frac{-ct\sin\theta + x\cos\theta}{\sin\alpha}\sqrt{\sin\alpha} = \frac{-ct\sin\theta + x\cos\theta}{\sqrt{\sin\alpha}} \tag{6}$$

This consequence could be a part of process to derive Lorentz transformation from the basic assumption.

Reference

[1] Tsuneaki Takahashi, viXra: 1611.0077,(http://vixra.org/abs/1611.0077)