

Copycat Of Relativity

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Woldemar Voigt had a theory of covariant wave equation in 1887. The Doppler effect can be applied to establish his theory if the speed of light can be assumed to be invariant in inertial reference frames. Voigt's theory was ignored by Hendrik Antoon Lorentz and the contemporary but was picked up by Albert Einstein. The theory of relativity was finalized in 1905 with a fatal error.

I. INTRODUCTION

Woldemar Voigt published a paper[1], "On Doppler's Principle", in 1887. Voigt speculated the homogeneous wave equations to be covariant in inertial reference frames. In order to apply Doppler effect to the wave equations, Voigt proposed the invariance of the speed of light in inertial reference frames. His resulting spacetime transformation was mostly ignored.

In 1892 George F. FitzGerald[2] and Hendrik Antoon Lorentz[3] proposed independently the contraction of a moving body in the direction of its motion. After a lengthy development, Lorentz found his transformation similar to Voigt's transformation. It is said that Lorentz once remarked that he could have taken Voigt's transformations into his theory of electrodynamics, if only he had known of them, rather than developing his own.

In 1905, Albert Einstein[4] copied Voigt's proposal to derive Lorentz's transformation. The theory of relativity took its final form. Little did Einstein know that the proposal from Voigt carried a fatal mistake.

II. PROOF

A. Doppler Effect

A stationary wave displays no frequency nor velocity to a stationary observer. To a moving observer the same wave will appear to move and exhibit frequency. The faster the observer moves, the higher velocity and frequency from the wave is observed.

The relative motion between the rest frame of the wave and the rest frame of the observer determines not only the speed of the wave but also the frequency of the wave.

Doppler effect[5] was proposed by Christian Doppler in 1842. The hypothesis was tested for sound waves by Buys Ballot in 1845. The sound pitch was confirmed to be higher than the emitted frequency when the sound source approached. However, Doppler effect describes sound wave which transmits differently from light.

For a stationary wave, the wavelength is invariant in inertial reference frames while its frequency depends on the relative motion of its observer. This has been verified by Su[6,7] for electromagnetic radiation.

B. Voigt Transformation

Voigt made a mistake when he applied Doppler effect to his covariance transformation. He assumed same velocity for different inertial reference frame but Doppler effect shows that the observed sound frequency is different in a different inertial reference frame. The wavelength of light is invariant in all inertial reference frames.

Voigt transformation can be written in modern matrix notation as

$$V_{\beta}^{\alpha} = \begin{vmatrix} 1 & -\frac{v}{c} & 0 & 0 \\ -\frac{v}{c} & 1 & 0 & 0 \\ 0 & 0 & \frac{1}{\gamma} & 0 \\ 0 & 0 & 0 & \frac{1}{\gamma} \end{vmatrix} \quad (1)$$

Spacetime transformation according to V_{β}^{α} is

$$\begin{vmatrix} ct' \\ x' \\ y' \\ z' \end{vmatrix} = V_{\beta}^{\alpha} \begin{vmatrix} ct \\ x \\ y \\ z \end{vmatrix} \quad (2)$$

Voigt did not realize there is an error in the inverse transformation of V_{β}^{α} . It could not restore the original inertial reference frame.

C. Lorentz Transformation

Lorentz also looked for the transformation under which Maxwell's equations are invariant when transformed from the aether to a moving frame. Together with Larmor, they extended the FitzGeraldLorentz contraction hypothesis and found out that the time coordinate has to be modified as well. In 1905, Poincare was the first to recognize that the transformation has the properties of a mathematical group, and named it after Lorentz.

Lorentz transformation can be written in modern matrix notation as

$$\Lambda_{\beta}^{\alpha} = \begin{vmatrix} \gamma & -\gamma\frac{v}{c} & 0 & 0 \\ -\gamma\frac{v}{c} & \gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} \quad (3)$$

Spacetime transformation according to Λ_{β}^{α} is

$$\begin{pmatrix} ct' \\ x' \\ y' \\ z' \end{pmatrix} = \Lambda_{\beta}^{\alpha} \begin{pmatrix} ct \\ x \\ y \\ z \end{pmatrix} \quad (4)$$

From equations (1,3),

$$\frac{1}{\gamma} \Lambda_{\beta}^{\alpha} = V_{\beta}^{\alpha} \quad (5)$$

Lorentz transformation is indeed proportional to Voigt transformation by a γ factor.

However, Voigt transformation is incorrect because its inverse transformation can not produce identity matrix.

$$V_{\beta}^{\alpha}(v)V_{\alpha}^{\beta}(-v) \neq \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \quad (6)$$

Lorentz transformation together with its inverse transformation can produce the identity matrix and restore the original inertial reference frame.

$$\Lambda_{\beta}^{\alpha}(v)\Lambda_{\alpha}^{\beta}(-v) = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \quad (7)$$

D. Copycat of Relativity

Albert Einstein is a well known copycat. Few of his idea is original. In 1905, Einstein copied Voigt's idea of invariant speed of light into his paper, "Zur Elektrodynamik bewegter Körper" [4]. By assuming the speed of light is invariant in all inertial reference frames, Einstein was able to derive Lorentz transformation. The derivation prevailed because Voigt had already proved it.

Few people understand that invariant speed of light is originally from Voigt, not from Einstein. More copycats copy this mistake further into Maxwell's equations and quantum field theory.

III. CONCLUSION

By copying Voigt's idea, Einstein also inherited Voigt's mistake. The mistake stays in the theory of relativity by assuming the invariance of the speed of light in inertial reference frames.

Sound wave transmits through air. The rest frame of air is different from the rest frame of the sound source. Hence, the wavelength changes. Electromagnetic radiation does not need any medium to transmit. Hence, the wavelength of light is invariant in inertial reference frames. Voigt had mistakenly identified sound transmission with light transmission.

Uttill 2020, the mistake still remains and spreads like virus in modern physics. Few physicists realize that the speed of light depends on the choice of inertial reference frame. The legend of this mistake was started by Voigt for his misunderstanding of Doppler effect.

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