AN ALTERNATIVE FORMULATION OF SPECIAL RELATIVITY

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This article presents an alternative formulation of special relativity which can be applied in any inertial reference frame. In addition, a new universal force is proposed.

Introduction

The invariant mass (m) and the frequency factor (f) of a massive particle are given by:

$$m \doteq m_o$$

$$f \doteq \left(1 - \frac{\mathbf{v} \cdot \mathbf{v}}{c^2}\right)^{-1/2}$$

where (m_o) is the rest mass of the massive particle, $(\mathbf{v})$ is the velocity of the massive particle and (c) is the speed of light in vacuum.

The invariant mass (m) and the frequency factor (f) of a non-massive particle are given by:

$$m \doteq \frac{h\,\kappa}{c^2}$$

$$f \doteq \frac{\nu}{\kappa}$$

where (h) is the Planck constant, (ν) is the frequency of the non-massive particle, (κ) is a positive universal constant with dimension of frequency and (c) is the speed of light in vacuum.

In this article, a massive particle is a particle with non-zero rest mass and a non-massive particle is a particle with zero rest mass.

The Alternative Kinematics

The special position ($\bar{\mathbf{r}}$), the special velocity ($\bar{\mathbf{v}}$) and the special acceleration ($\bar{\mathbf{a}}$) of a (massive or non-massive) particle are given by:

$$\bar{\mathbf{r}} \doteq \int f \, \mathbf{v} \, dt$$

$$\bar{\mathbf{v}} \doteq \frac{d\bar{\mathbf{r}}}{dt} = f \, \mathbf{v}$$

$$\bar{\mathbf{a}} \doteq \frac{d\bar{\mathbf{v}}}{dt} = f \, \frac{d\mathbf{v}}{dt} + \frac{df}{dt} \, \mathbf{v}$$

where (f) and ($\mathbf{v}$) are the frequency factor and the velocity of the particle.

The Alternative Dynamics

If we consider a (massive or non-massive) particle with invariant mass m then the linear momentum $\mathbf{P}$ of the particle, the angular momentum $\mathbf{L}$ of the particle, the net force $\mathbf{F}$ acting on the particle, the work W done by the net force acting on the particle, and the kinetic energy K of the particle, for an inertial reference frame, are given by:

$$\mathbf{P} \doteq m \, \bar{\mathbf{v}} = m \, f \, \mathbf{v}$$

$$\mathbf{L} \doteq \mathbf{P} \times \mathbf{r} = m \, \bar{\mathbf{v}} \times \mathbf{r} = m \, f \, \mathbf{v} \times \mathbf{r}$$

$$\mathbf{F} = \frac{d\mathbf{P}}{dt} = m \, \bar{\mathbf{a}} = m \left[f \, \frac{d\mathbf{v}}{dt} + \frac{df}{dt} \, \mathbf{v} \right]$$

$$\mathrm{W} \doteq \int_1^2 \mathbf{F} \cdot d\mathbf{r} = \int_1^2 \frac{d\mathbf{P}}{dt} \cdot d\mathbf{r} = \Delta \, \mathrm{K}$$

$$\mathrm{K} \doteq m \, f \, c^2$$

where (f, $\mathbf{r}$, $\mathbf{v}$, $\bar{\mathbf{v}}$, $\bar{\mathbf{a}}$) are the frequency factor, the position, the velocity, the special velocity and the special acceleration of the particle relative to the inertial reference frame and (c) is the speed of light in vacuum. The kinetic energy (K_o) of a massive particle at rest is ($m_o \, c^2$)

The Kinetic Force

In an isolated system of (massive or non-massive) particles, the kinetic force $\mathbf{K}_{ij}$ exerted on a particle i with invariant mass m_i by another particle j with invariant mass m_j is given by:

$$\mathbf{K}_{ij} \;=\; - \left[\; \frac{m_i \, m_j}{\mathrm{M}} \, (\, \bar{\mathbf{a}}_i - \bar{\mathbf{a}}_j \,) \right]$$

where $\bar{\mathbf{a}}_i$ is the special acceleration of the particle i, $\bar{\mathbf{a}}_j$ is the special acceleration of the particle j and M ($= \sum_z m_z$) is the invariant mass of the isolated system of particles.

From the above equation it follows that the net kinetic force $\mathbf{K}_i$ ($= \sum_z \mathbf{K}_{iz}$) acting on the particle i is given by:

$$\mathbf{K}_i \;=\; - \, m_i \, \bar{\mathbf{a}}_i$$

where m_i is the invariant mass of the particle i and $\bar{\mathbf{a}}_i$ is the special acceleration of the particle i.

Now, substituting ($\mathbf{F}_i = m_i \, \bar{\mathbf{a}}_i$) and rearranging, we obtain:

$$\mathbf{T}_i \;\doteq\; \mathbf{K}_i + \mathbf{F}_i \;=\; 0$$

Therefore, in an isolated system of (massive or non-massive) particles, the total force $\mathbf{T}_i$ acting on a particle i is always zero.

In this article, the linear momentum of an isolated system of (massive or non-massive) particles is conserved ($\sum_z m_z \, \bar{\mathbf{v}}_z = constant$)

Bibliography

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E. Mach, The Science of Mechanics.

W. Pauli, Theory of Relativity.

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Appendix I

System of Equations I

		[1]		
		$\downarrow dt \downarrow$		
[4]	$\leftarrow \times \mathbf{r} \leftarrow$	[2]		
$\downarrow dt \downarrow$		$\downarrow dt \downarrow$		
[5]	$\leftarrow \times \mathbf{r} \leftarrow$	[3]	$\rightarrow \int d\mathbf{r} \rightarrow$	[6]

[1] $$\frac{1}{\mu}\left[\int \mathbf{P}\, dt - \int\!\!\int \mathbf{F}\, dt\, dt\right] = 0$$

[2] $$\frac{1}{\mu}\left[\mathbf{P} - \int \mathbf{F}\, dt\right] = 0$$

[3] $$\frac{1}{\mu}\left[\frac{d\mathbf{P}}{dt} - \mathbf{F}\right] = 0$$

[4] $$\frac{1}{\mu}\left[\mathbf{P} - \int \mathbf{F}\, dt\right] \times \mathbf{r} = 0$$

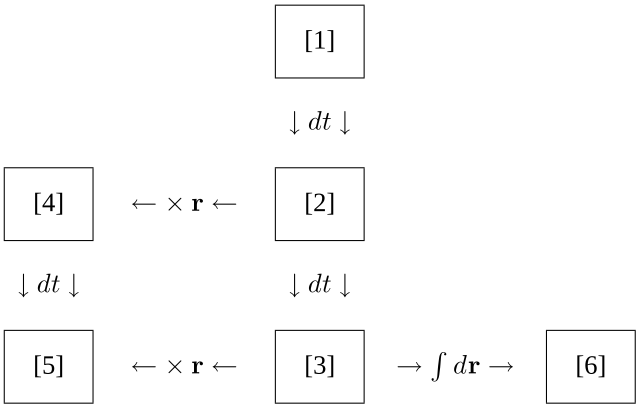
[5] $$\frac{1}{\mu}\left[\frac{d\mathbf{P}}{dt} - \mathbf{F}\right] \times \mathbf{r} = 0$$

[6] $$\frac{1}{\mu}\left[\int \frac{d\mathbf{P}}{dt} \cdot d\mathbf{r} - \int \mathbf{F} \cdot d\mathbf{r}\right] = 0$$

[μ] is an arbitrary constant with dimension of mass (M)

Appendix II

System of Equations II



[1] $$\frac{1}{\mu}\left[m\,\bar{\mathbf{r}} - \iint \mathbf{F}\,dt\,dt \right] = 0$$

[2] $$\frac{1}{\mu}\left[m\,\bar{\mathbf{v}} - \int \mathbf{F}\,dt \right] = 0$$

[3] $$\frac{1}{\mu}\left[m\,\bar{\mathbf{a}} - \mathbf{F} \right] = 0$$

[4] $$\frac{1}{\mu}\left[m\,\bar{\mathbf{v}} - \int \mathbf{F}\,dt \right] \times \mathbf{r} = 0$$

[5] $$\frac{1}{\mu}\left[m\,\bar{\mathbf{a}} - \mathbf{F} \right] \times \mathbf{r} = 0$$

[6] $$\frac{1}{\mu}\left[m\,f\,c^2 - \int \mathbf{F}\cdot d\mathbf{r} \right] = 0$$

$[\mu]$ is an arbitrary constant with dimension of mass (M)