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 intrinsic 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 intrinsic 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 intrinsic 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

The kinetic force $\mathbf{K}^a_{ij}$ exerted on a particle i with intrinsic mass m_i by another particle j with intrinsic mass m_j is given by:

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

where $\bar{\mathbf{a}}_i$ is the special acceleration of particle i, $\bar{\mathbf{a}}_j$ is the special acceleration of particle j and $\mathbb{M}$ ($= \sum_z m_z$) is the sum of the intrinsic masses of all the particles of the Universe.

The kinetic force $\mathbf{K}^u_i$ exerted on a particle i with intrinsic mass m_i by the Universe is given by:

$$\mathbf{K}^u_i \;=\; - \, m_i \, \frac{\sum_z m_z \, \bar{\mathbf{a}}_z}{\sum_z m_z}$$

where m_z and $\bar{\mathbf{a}}_z$ are the intrinsic mass and the special acceleration of the *z*-th particle of the Universe.

From the above equations it follows that the net kinetic force $\mathbf{K}_i$ ($= \sum_j \mathbf{K}^a_{ij}$ $+ \mathbf{K}^u_i$) acting on a particle i with intrinsic mass m_i is given by:

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

where $\bar{\mathbf{a}}_i$ is the special acceleration of 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, the total force $\mathbf{T}_i$ acting on a particle i is always zero.

Bibliography

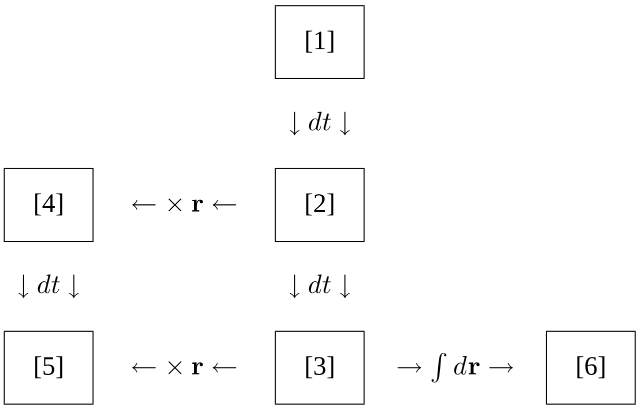
A. Einstein, Relativity: The Special and General Theory.

E. Mach, The Science of Mechanics.

W. Pauli, Theory of Relativity.

Appendix I

System of Equations I



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

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

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

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

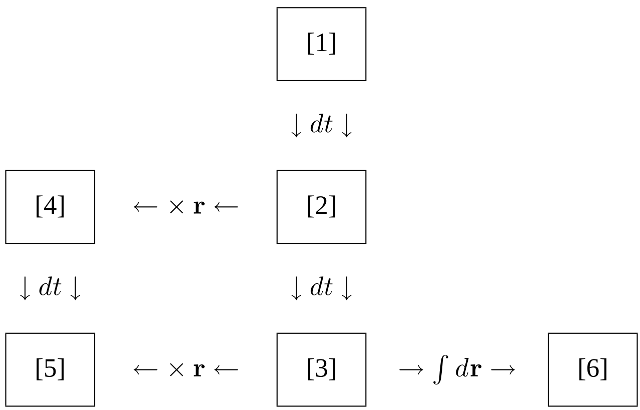
$$[5] \qquad \frac{1}{\mu}\left[\frac{d\mathbf{P}}{dt} - \mathbf{F}\right] \times \mathbf{r} = 0$$

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

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

Appendix II

System of Equations II



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

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

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