Modern Space-Time

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Abstract

The Interdefinition of Length and Time

Since 1983, the meter, second and speed of light "c" have been defined by
N meters = c * 1 second with N = 299,792,458.
We find, that's had a profound effect on Relativity Theory.
In the MKS system of units we have the basis vectors $\vec{e}^{\,0}, \vec{e}^{\,1}, \vec{e}^{\,2}, \vec{e}^{\,3}$ such that the magnitudes are,

$$\left|\vec{e}^{\,i}\right| = 1\,meter, \{i = 1, 2, 3\}\ and\ \left|\vec{e}^{\,0}\right| = c * 1\,\mathrm{sec}\,ond\,. \qquad (1)$$

These are related by $N * \left|\vec{e}^{\,i}\right| = \left|\vec{e}^{\,0}\right|$ as per International definition. We may of course eliminate the N by an arbitrary change in the length scale to simplify to $\left|\vec{e}^{\,i}\right| = \left|\vec{e}^{\,0}\right|$.
With it understood the $\left|\vec{e}^{\,u}\right|$ are the 4D basis vectors, we define our metrics by the scalar products herein,

$$g_{uv} = \vec{e}_u \cdot \vec{e}_v \ \ and\ g^{uv} = \vec{e}^{\,u} \cdot \vec{e}^{\,v}, \qquad (2)$$

being the covariant and contra variant metric tensors.

In a Cartesian Coordinate System that yields,

$$g_{00} = g_{11} = g_{22} = g_{33} = 1. \qquad (3)$$

An Alternative to the conventional Minkowski Metric.

In flat space we set $g_{00} = g_{11} = g_{22} = g_{33} = 1\ and\ g_{0i} = -dx^i / dx^0$, that and that works well when merging SR with GR, neatly expressed,

$$U_i U^i = 0 \qquad (4)$$

as the definition the modern Theory of Relativity as required by the new 1983 definition of time.

Expand that to detail time and space as,

$$U_0 U^0 + U_i U^i = 1, \{i = 1, 2, 3\} \qquad (5)$$

The $U_i U^i$ is *absolute velocity* and since one can always find a CS where motion of something is zero, is the same as saying motion is relative,
hence, $U_i U^i = 0 = \textit{absolute motion}$ is the
covariant way (for all CS's using tensors) of writing "motion is relative".
Of course relative motion is retained by U^i and being non-zero generally produces,

$$U_i = 0 \text{, generally.} \tag{6}$$

Now we can use association to obtain,

$$U_i = g_{i\mu} U^\mu = 0 \tag{7}$$

and expand index "μ" in time and space $\{0, i\}$ to,

$$0 = g_{i0} U^0 + g_{ij} U^j \tag{8}$$

Using algebra we see,

$$g_{i0} = -g_{ij} U^j / U^0 = -g_{ij} dx^j / dx^0 \,. \tag{9}$$

Specifying a flat space-time metric g_{ij} simplifies to the Kronecker delta and so,
$g_{i0} = -dx^i / cdt$,
simplified, and is aberration...a real effect well established by experiment.

Now we substitute the nonorthogonal components in
in $ds^2 = g_{\mu\nu} dx^\mu dx^\nu$ by expanding indices "μ" and "ν" over time and space,

$$ds^2 = g_{00} dx^o dx^0 + 2 g_{oi} dx^0 dx^i + g_{ij} dx^i dx^j \tag{10}$$

From Equation (9) substitute in $g_{0i} = -g_{ij} dx^j / dx^0$ and get

$$ds^2 = g_{00} dx^0 dx^0 - g_{ij} dx^i dx^j \text{ (generally) ,} \tag{11}$$

substituting in a simplified metric $g_{00} g_{11} ... = 1 \; and \; dx^0 = cdt$ to get the familiar

$$ds^2 = c^2 dt^2 - dx^2 - dy^2 - dz^2 \tag{12}$$

that Minkowski and later Einstein needed for GR.

The relative motion and the vanishing of *absolute* motion has been deduced to $U_i = 0$.
Above, we see the only metric compatible with $U_i = 0$ is,

$$ds^2 = g_{00} dx^0 dx^0 - g_{ij} dx^i dx^j \text{ (generally).} \tag{13}$$

Note: The $\sqrt{1}$ is not applicable or possible in time or space,
(it may be mathematically possible to transform $\sqrt{-1}$ axes to normal axes).

For Conception Dynamics
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