Modern Space-Time

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Abstract

<u>The Interdefinition of Length and Time.</u>

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,

$$\left|\vec{e}^{\,i}\right| = 1 meter, \{i = 1, 2, 3\}\ and\ \left|\vec{e}^{\,0}\right| = c * 1\,second\ . \tag{1}$$

These are related by N ∗ |~ei| = |~e0| 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,

$$g_{uv} = \vec{e}_u \bullet \vec{e}_v\ and\ g_{uv} = \vec{e}^{\,u} \bullet \vec{e}^{\,v}\ , \tag{2}$$

being the covariant and contravariant metric tensors.

In a Cartesian Coordinate System that yields,

$$g_{00} = g_{11} = g_{22} = g_{33} = 1. \tag{3}$$

<u>An Alternative to the conventional Minkowski Metric.</u>

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,

$$U_i U^i = 0 \tag{4}$$

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

Expand that to detail time and space as,

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

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, $U_iU^i = 0 = absolute\ motion$ 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,

$U_i = 0$, generally. (6)

Now we can use association to obtain,

$$U_i = g_{i\mu}U^{\mu} = 0 \quad (7)$$

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

$$0 = g_{i0}U^0 + g_{ij}U^j \quad (8)$$

Using algebra we see,

$$g_{i0} = -g_{ij}U^j / U^0 = -g_{ij}dx^j / dx^0 \quad (9)$$

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,

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

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

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

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

$$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2 \quad (12)$$

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,

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

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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