**Three-Dimensional Duality of Length and Duration – draft – outtakes**

Substitute the constitutive relation () into equation () to get the following expression in terms of only the fields **E** and **H**:

Assuming the physical properties are homogeneous throughout the time-distance domain, *μ*, *ϵ*, and *σ* can be moved out front of the derivative terms. This simplifies ():

If we further assume that we can take the first and second derivatives of **E**, we can either take the length space derivatives first or the duration space derivatives first. Equation () can then be written as:

This expression is now solely in terms of Δ**x** × **E** and Δ**x** × **H**. Next use equations (), ( ) ( ) to generate an equation with only **E**:

Then simplify the left hand side of () by using the vector identity:

Recalling that Δ**x · E** is zero in a homogenous space, the vector identity becomes

Substitute that into () to get the following:

This is the wave equation for the electric field in time-distance domain. If the charge is zero, then σ = 0, and the wave equation with *με* = *c*−2 is

*Complete Magnetic Field*

To derive the wave equation for **H**, we repeat the above derivation but start by taking the length curl of Ampere’s complete law, shown in equation ():

The constitutive relations can be substituted into equation (16) to get the following expressions in terms of only **E** and **H**:

We simplify () just as we did before for the electric field.

We can assume that we can take the first and second derivatives of **E** and **H** and can either take the spatial derivatives or duration derivatives first. Equation () can then also be written as:

These expressions are now in terms of Δ**x** × **E** and Δ**x** × **H**. Thus, we can use equation () to generate an equation with only **H**. Then again use the vector identity () and the fact that Δ**x · H** is zero in a homogenous space to simplify the vector identity, which is then substituted into the wave equation:

Equation () is then the wave equation for the magnetic field in the time-distance domain. If the current is zero, then *σ* = 0, and the wave equation with *με* = *c*−2 is

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Events with the same elapsed time from a common reference point are members of an equivalence class of *simultaneous* events. Events with the same elapsed distances from a common reference point are members of an equivalence class of *simuldistant* events. The difference between simuldistant and equidistant is that the latter means the same distance from a point, whereas the former means with the same elapsed distance equivalence class.

*Time* *t* is an equivalence class of equal distimes. An equivalence class of equal distances is called here the *equistance* *r*.

*equistance* is an equivalence class of points equidistant from a common length space point. *time* is an equivalence class of equal distime points from a common duration space pt.

Although the above is sufficient for measuring magnitudes and directions, the direction can be measured directly with an angular frame of reference system. Consider two rigid annuli linked to each other and moving alongside each other in uniform motion with respect to one another at the elapse rate. Call this a *clock-annulus*.

The annulus at rest relative to the observer is called the *length annulus*. The adjacent rod is called the *duration annulus*. The length annulus is moving in the opposite direction relative to the duration annulus (or another observer at rest relative to the duration annulus) as depicted in Figure 5.

A circular object with text

Description automatically generated

Figure 5. Clock-annulus

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so that the magnitude of **x** equals the distance *r*, and the magnitude of **z** equals the distime *t*.

The differential distance in Cartesian coordinates is:

And the differential distime in Cartesian coordinates is:

The time rate of rotation in length space is the angular velocity **ω**, and the distance rate of rotation in duration space is the angular lenticity **ψ**:

Table 4. Angular Rates of Motion

|  |  |
| --- | --- |
| Angular Velocity | Angular Lenticity |
|  |  |

According to the conventionality thesis, the one-way velocity of light is not measurable, so one could represent the forward and return speeds of light as *c*1 and *c*2, and the result would be the same. The initial direction has no effect on the result, which is also consistent with Michelson-Morley.

The rod at rest relative to the observer is called the length rod. The adjacent rod, called the duration rod, is in motion relative to it. The length rod is moving in the opposite direction relative to the duration rod (or an observer at rest relative to the duration rod).

The *time domain* consists of elapsed time with length space. The *distance domain* consists of elapsed distance with duration space.

Abstract: Galileo’s *Two New Sciences* hints of a duality of length and duration that is explored here by expanding the frame of reference to include measurement of duration in parallel with length. The duality of length and duration in three dimensions is shown. A dual classical mechanics is defined, including dual rates of motion, duals to Newton’s laws of motion, and the dual of gravitation. Maxwell’s equations and the wave equation are completed and shown to be invariant under the complete Galilean transformations. A re-examination of the light clock and Michelson-Morley experiment results in a correction.

The three dimensions of duration have been unobserved because of the limitations of the common frame of reference.

A complete dual classical mechanics was defined, including new rates of motion, duals to Newton’s laws of motion, and the dual of gravitation, called levitation. Maxwell’s equations and the wave equation are completed and shown to be invariant under the complete Galilean transformations.

The light clock is re-examined and reflected light is shown to be invariant under the Galilean transformations. An error in the Michelson-Morley experiment is corrected.

with dual rates of motion, duals to Newton’s laws of motion, and the dual of gravitation

Classical space and time concepts are incomplete without three dimensions of duration. Herein is presented a frame of reference system that includes three dimensions of duration along with three dimensions of length. Its completeness is demonstrated for inertial observers.

First presented is the frame of reference required to include three dimensions of motion with two measures of extent. Second, motion and rates of motion are defined, then dual Newtonian dynamics, symmetry and conservation. Next a two-way wave equation is derived and shown to be invariant under the complete Galilean transformations. Then the light clock is re-examined.

The angle of rotation in length space is *θ*, and the angle of rotation in duration space is *ϕ*.

The dimensions of the gravitational constant are [M−1 L3 T−2], and those of the levitational constant are [M1 L−2 T3].

… relative to two observers *K* and *K′*, the relative velocity **v** of the primed to the unprimed time domain, and the elapsed time *t*. Let **v** be along the *x*1-*x*1′ axis (see Figure 5).

[**x**, *t*; **z**, *s*] and [**x′**, *t′*; **z′**, *s′*]

comprised of dual time-domain and distance domain transformations.

The distance domain Galilean transformation takes dischronments **z** and **z′** relative to the two observers, *S* and *S′*, the relative lenticity **w** of the primed to the unprimed distance domain, and the elapsed distance *s*. Let **w** be along the *z*1-*z*1′ axis (see Figure 6).

*First Law: Every body perseveres in its state of rest or of uniform motion in a straight line, except insofar as it is compelled to change its state by forces impressed.*

*Second Law: A change in momentum is proportional to the force impressed and takes place along the straight line in which that force is impressed.*

*Third Law: To any force there is always an opposite and equal reaction; in other words, the force of two bodies upon each other are always equal and always opposite in direction.*

*Dual First Law: Every body continues in its state of rest or of uniform motion in a straight line, except insofar as it is compelled to change its state by applied releases.*

*Dual Second Law: A change in levamentum is proportional to the release applied and takes place along the straight line in which that release is applied.*

*Dual Third Law: To any release there is always an opposite and equal reaction; in other words, the releases of two bodies upon each other are always equal and always opposite in direction.*

As force is proportional to mass, so release *R* is inversely proportional to mass and directly proportional to vass *n*. As force is proportional to acceleration, so release is proportional to relentation *b*: *R = nb*. As force is the time rate of change of momentum, define the *release* as the distance rate of change of levamentum.

Newton postulated a gravitational force in the time domain that is directed along the straight line between two bodies, is directly proportional to the product of their masses, and is inversely proportional to the square of the distance between them.

The law of gravitation can be stated as:

*Every particle of matter attracts every other particle with a force that is directly proportional to the product of the masses of the particles and inversely proportional to the square of the distance between them.*

The gravitational force for masses *m* and *M* with distance *r* between them is:

with *G* as the gravitational constant of proportionality.

Thus the law of levitation can be stated as:

*Every particle of matter attracts every other particle with a release that is directly proportional to the product of the vasses of the particles and inversely proportional to the square of the distime between them.*

Levitational release *R* is inversely proportional to the square of the distime between vasses *q*, and directly proportional to the product of the two vases, *n* and *N*:

with a levitation constant *L* as the constant of proportionality.

[domains] They usually are but need not be mathematically independent, *i.e.*, functional arguments.

Another approach is to find the mean velocity directly by the harmonic mean:

Since the speed *v* drops out, the total time is independent of any speed *v*.

While the introduction of concepts such as levitation may be surprising, it is good to recall Ernst Mach’s words:

The universe is not *twice* given, with an earth at rest and an earth in motion; but only *once* with its *relative* motions, alone determinable. (p. 284 in [23])

Distance velocities are inverted to make lenticities, then added, then inverted again to return to a distance velocity.

The mean pace is again *k*, shown as the harmonic mean distance speed of light, c.

I.e., elapsed time is the duration of an independent uniform motion.