www.Distinti.com

EM04: New Electromagnetism V5

By Robert J Distinti M.S.ECE
Box 837, New Milford PA, 18834
www.EtherealMechanics.com
www.Distinti.com
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New Electromagnetism V5

ABSTRACT

This paper develops the interfragmentary forms of New Electromagnetism Version 5 (NEV5) suitable for electrical engineering applications. These forms account for previously unknown charge motion effects that include centripetal, coriolis and venturi effects. Included are the interfragmentary forms of the new Magnetic Force model, first introduced in Electrogravity [EG], and the Inertial Force model (New Induction V1) that began the New Electromagnetism franchise in the mid 1990s. These interfragmentary forms are combined to yield advanced models of magnets and conductors that will revolutionize the field of electrical engineering. New Electromagnetism is the 4th paper in the Ethereal Mechanics series of papers [EM04].

Chapter 1 highlights foundational constructs and definitions required to understand the contents of this paper. The point forms of the NEV5 models are introduced in chapter 2.

Topics Include:

1) Improved Fragmentary Wire Model (FWM)
2) FWM derivatives of Inertial, Magnetic and Electric forces
3) Venturi, Coriolis and Centripetal charge effects (Never Before Released)
4) Inductive and Hall Effects
5) Improved Model of Magnets.
6) Experimental Corroboration (Chapter 7)
    a. Hall Effect (Section 6.1)
    b. Homopolar Generator (Paradox 1) [PDX1]
    c. Spinning Magnet Experiments, 54 total variants of PDX2, PDX3 and PDX4 [PDX234]
    d. The most accurate models of self-inductance [THESIS]
        i. Printed Circuit Board (PCB) Traces
        ii. PCB Traces with ground plane
        iii. PCB Traces sandwiched between two ground planes
    e. Many Experimental Supplements follow.

NEV5 is superior in the following ways:

1. Full Vortrix Derivations and Simulations.
2. Faster, simpler computer modeling – everything reduced to optical modeling (line of sight)
3. No violations of locality in translation or rotation (unlike classical models)
4. No arbitrary constants of relation (ACORs)
    a. There are normal constants like C and optional conversion constants.
5. No ambiguities
6. No oversubscription of effects
    a. Example from classical theory: Faraday's Model and F=QVxB overlap.
7. Fully Transvariant compliant [EM01]
8. Others

A newer version (5.02) available in 2025 includes:

1) More field effects
2) More experiments
3) Typo corrections
4) New Vortrix Structures

1 Foundation

This chapter contains precursory information needed to better assimilate the models introduced in Chapter 2.

1.1 Constants and Arbitrary Constants of Relation

Ethereal Mechanics obeys the Rules of Scientific Acquisition (there are presently 36). The 24^{th} Rule of Acquisition requires that a theory of everything be free of arbitrary constants of relation (ACOR). An ACOR relates the right side of an equation to the left side. An example of an ACOR is the gravity constant G. ACORs are essentially coefficients resulting from the regression of experimental data; therefore, they are empirical quantities and remain empirical with unknown origin/meaning until someone is able to derive them from the underlying mechanisms of nature (as was done with G in Electrogravity [EM03]). Once their origin is known their meaning is no longer arbitrary and they become normal constants.

ACORs should not be confused with arbitrary units of measure such as the meter or second. ACORs should not be confused with normal constants such a C (the speed of light) or Avogadro's number which have known origin/meaning which. ACORs should not be confused with conversion constants such as feet per meter etc.

This discussion is expanded in section 8.1.1: Distinti's Rules of Scientific Acquisition

1.2 Natural and Legacy Units

Ethereal Mechanics is built upon natural units which expose the underling structures of nature. This is not to be confused with other systems of "Natural Units" derived from arbitrary constants of relation (see https://en.wikipedia.org/wiki/Natural_units) which only serve to obscure natural structures. This section is only a brief introduction, for a full treatment, see Ethereal Mechanics: Constructs [EM02].

To avoid confusion and remain compliant with Constructs [EM02], legacy units are type faced in blue.

Example:

$$\text{Force} \equiv I^2 \ \text{(Square Ampers)} \quad \text{Newtons (Natural Newtons)}$$

$$\text{Force} \equiv \frac{Kgm}{S^2} \quad \text{Newtons (Legacy Newtons)}$$

Another example of Natural units is Inertia. Inertia is a property of matter synthesized by two charges (Q) separated by a distance (m). Thus, the natural units of inertia are square coulombs per meter as given by the following relationship

$$Burls = B = \frac{Q^2}{m}$$

The unit is named the Burl which is short for burliness synonymous with heaviness. The abbreviated unit representation is the letter B and the default symbol used to represent inertia as a variable in equations is the symbol B.

Burls can be converted to the Legacy units of inertia, the kilogram, using the conversion constant K_M.

$$K_M = \frac{\mu_0}{4\pi} = \frac{Kgm}{Q^2} = \frac{Kg}{B} = \quad 1\times 10^{-7}\frac{Kg}{B}$$

The reader might be confused why the magnetic field constant is being used in this way; however, the Rules of Acquisition forbid a theory of everything from having arbitrary constants of relation (ACOR). The reasoning is that science is based upon arbitrary units of measure, if the units are properly ascribed (no missing or oversubscribed units) there should be no need for ACORs just as there is no ACOR in F=MA or ohms law (E=IR). The constant of relation μ_0 arose because scientist oversubscribed the kilogram which is used as both a quantity of stuff and inertia of stuff. This constant is merely a conversion from natural inertia to quantity of stuff. This discussion is expanded in section 8.1.1.

To convert natural inertia (B) to legacy inertia (M)

$$M = K_M B \quad \left(Kg\right)$$

Inertia is a critical part of the natural expression for force given by

$$Force = \mathbf{F} = B\mathbf{a} \quad \text{Natural Force } \left(\text{Square Amperes}\right)$$

Bold face symbols represent Vortrix Vector quantities (explained in section 1.3).

To convert natural newtons (F) to legacy newtons (F)

$$\mathbf{F} = K_M \mathbf{F} \quad \left(\frac{Kg\,m}{s^2}\right)$$

A more complete list of natural units and conversion to legacy units is found in Ethereal Mechanics: Constructs [EM02].

1.3 Vortrix Algebra (VA)

Vortrix Algebra [VA] is an evolution of legacy vector algebra. Legacy vector algebra is incomplete because it does not provide a vector divide (inverse operation to a vector product). In fact, the available vector products, the cross and dot products, are themselves incomplete and do not provide enough information to support an inverse product.

Vortrix Algebra is a more rigorous and complete definition of vectors and matrices. In fact, it expresses the wonderful behaviors of complex numbers and quaternions without the need for imaginary numbers or operators.

Vortrix Algebra provides a complete vector product and inverse product that enables the development of true vector calculus because it is now possible to compute limits for all vector expressions. Legacy Vector algebra could only evaluate limits for trivial expressions.

The preferred name for this new mathematics is Vortex Algebra; however, that name was already taken. So the name Vortex Matrix Algebra is contracted to Vortrix Algebra.

All of the vector derivations and mathematical expressions shown in this paper are in Vortrix Algebra notation. Because Vortrix Algebra is new, there are literally no examples available except in the other Ethereal Mechanics papers; therefore, Vortrix derivations are fully expanded in order to provide examples.

The Vortrix Algebra paper is available [VA]

The important properties/identities of Vortrix Algebra used in this paper are highlighted here.

Even vector products result in a matrix

The multiplication or division of an even number of vectors results in a vortex matrix denoted by the brackets in the following identities. The brackets are used on matrix variables (such as D and M) to distinguish them from vectors,

$$[\mathbf{M}] = [\mathbf{AB}], [\mathbf{D}] = [\mathbf{A}/\mathbf{B}]$$

Odd vector products result in a vector

$$\mathbf{D} = [\mathbf{AB}]\mathbf{C}$$

Product operators have left and right "flavors"

$$[\mathbf{AB}]^T = [\mathbf{BA}]$$

$[\mathbf{A}/\mathbf{B}]^T = [\mathbf{B}\backslash\mathbf{A}]$ relation between right and left divide

$$\mathbf{C}[\mathbf{AB}] \neq [\mathbf{AB}]\mathbf{C}$$

$\mathbf{C}[\mathbf{AB}] = [\mathbf{AB}]^T\mathbf{C} = [\mathbf{BA}]\mathbf{C}$ double transpose

Relationship between multiply and divide

$[\mathbf{A}/\mathbf{B}] = \dfrac{[\mathbf{BA}]}{|\mathbf{B}|^2} = \dfrac{[\hat{\mathbf{B}}\mathbf{A}]}{|\mathbf{B}|}$ right divide replaced with left multiply

$$[\mathbf{A}/\hat{\mathbf{B}}] = \frac{[\hat{\mathbf{B}}\mathbf{A}]}{|\hat{\mathbf{B}}|} = [\hat{\mathbf{B}}\mathbf{A}]$$

$$[\mathbf{AB}]/\mathbf{C} = \frac{\mathbf{C}[\mathbf{AB}]}{|\mathbf{C}|^2} = \frac{\hat{\mathbf{C}}[\mathbf{AB}]}{|\mathbf{C}|}$$

$[\mathbf{A}\backslash\mathbf{B}] = \dfrac{[\mathbf{BA}]}{|\mathbf{A}|^2} = \dfrac{[\mathbf{B}\hat{\mathbf{A}}]}{|\mathbf{A}|}$ left divide replaced with right multiply

$$\mathbf{C}\backslash[\mathbf{AB}] = \frac{[\mathbf{AB}]\mathbf{C}}{|\mathbf{C}|^2} = \frac{[\mathbf{AB}]\hat{\mathbf{C}}}{|\mathbf{C}|}$$

1.3.1 Properties of the Vortrix Product

The product of two vectors forms a matrix. This matrix can operate on a vector or another matrix. In 2D space (two dimensional space), the operation on a vector produces a scaled and rotated result which is demonstrated in the following examples. In 3D, the operation can also produce a volume term which has not yet been correlated to a physical manifestation in electromagnetic theory.

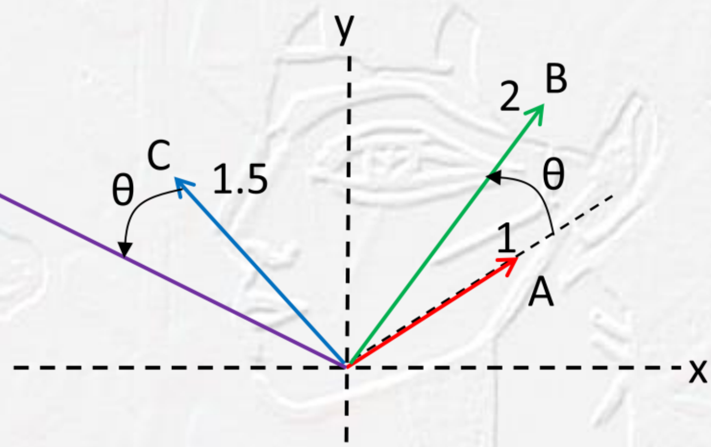


Figure 1-1: D=[AB]C Vortrix Product Example

Given vectors **A**, **B**, **C** that exist in the same plane (Figure 1-1), the Vortrix Product [**AB**]**C** results in vector **D** where.

$$\mathbf{D} = \left[\mathbf{B} / \mathbf{A}\right]\mathbf{C}$$

$$|\mathbf{D}| = \frac{|\mathbf{B}|}{|\mathbf{A}|}|\mathbf{C}|$$

$$D\measuredangle = C\measuredangle + (B\measuredangle - A\measuredangle)$$

It should be plain to see the manner in which the matrix [**B**/**A**] operates on **C** to produce **D**. Basically the changes from **A** to **B** are applied to **C**. This is similar to the behavior of complex numbers described in section 1.3.2

Using the identities mentioned above, the right divide of **A** can be replaced with a left multiply of **A**. Since **A** is a unit vector, the same result is achieved as shown in the following.

$$\mathbf{D} = \left[\mathbf{AB}\right]\mathbf{C}$$

$$|\mathbf{D}| = |\mathbf{A}||\mathbf{B}||\mathbf{C}|$$

$$D\measuredangle = C\measuredangle + (B\measuredangle - A\measuredangle)$$

1.3.2 Relationship with Complex Algebra

Vortrix Algebra in 2D is a direct replacement for complex algebra. Figure 1-2 is an example used to demonstrate this relationship. The example maps the real dimension of complex algebra to the Vortrix x dimension and the imaginary is mapped to the y dimension. NOTE: this is new material not released in the Vortrix paper [VA].

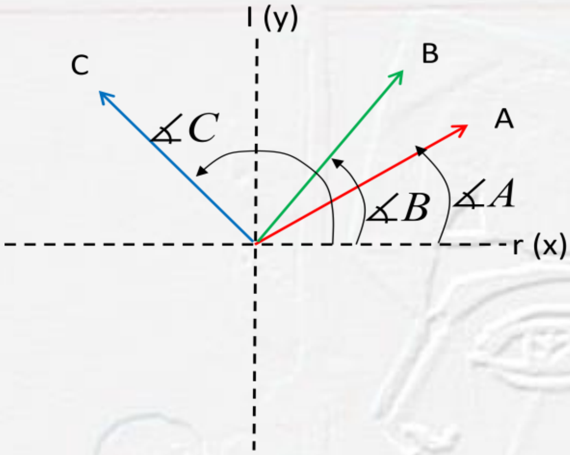


Figure 1-2: Example of Vortrix algebra used for Complex Algebra

The major difference between Vortrix algebra (for 2D) and complex algebra is that the direction of Vortrix vectors is inherent while the direction of complex vectors is relative to the real (x) axis.

The product of A and B in complex algebra is described as follows. The vectors A and B are represented as complex values shown as lower case a and b.

$$c = ab = ba$$
$$|c| = |a||b|$$
$$\measuredangle c = \measuredangle a + \measuredangle b$$

To achieve the same behavior using Vortrix Algebra, one multiplicand need only be referenced to the x axis as shown.

$$\mathbf{C} = \left[\hat{\mathbf{x}}\mathbf{A}\right]\mathbf{B} = \left[\hat{\mathbf{x}}\mathbf{B}\right]\mathbf{A}$$
$$|\mathbf{C}| = |\mathbf{A}||\mathbf{B}|$$
$$\measuredangle \mathbf{C} = \measuredangle \mathbf{A} + \measuredangle \mathbf{B}$$

The relationship between Complex Conjugate and Vortrix Transpose 2D

To further illustrate the similarity of 2D Vortrix algebra and complex algebra, the relationship of the Vortrix transpose and the complex conjugate is demonstrated.

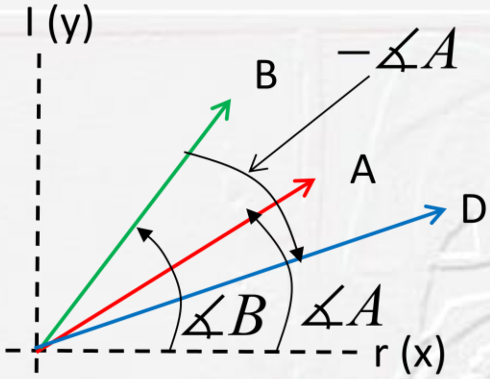


Figure 1-3: Transpose, Conjugate Example

$$a^* = [\hat{\mathbf{x}}\mathbf{A}]^T = [\mathbf{A}\hat{\mathbf{x}}] \quad \{\text{2D only}\}$$

$$\mathbf{D} = [\mathbf{A}\hat{\mathbf{x}}]\mathbf{B}$$

$$\measuredangle\mathbf{D} = -\measuredangle\mathbf{A} + \measuredangle\mathbf{B}$$

Vortrix Algebra is a direct replacement for complex algebra. No imaginary numbers of complex operators required; everything is real – as it should be.

1.4 The Reference Frame

This paper demonstrates NEV5 in normal laboratory environments at human time scales. As such, this paper uses the Earth Surface Small Scale Ether Model. In this model, the motion of the medium tangent to the surface is the Earth is essentially negligible. Normal to the surface of the Earth, the medium accelerates Earthward at approximately 9.8 meters per second squared and the velocity is estimated to be approximately 11000 meters per second Earthward.

The motion of the medium is not detectable by the simple experiments discussed in this paper. An experiment discussed in a later paper exposes the Earthward Ethereal motion.

1.5 Voltage vs. Vimage (formerly emf)

The legacy quantity known as electromotive force (emf) is a term in need of replacement for many reasons. A main reason is confusion over the use of the word "Force"; emf is voltage not force. The ISO/IEC standards organization have also deprecated the term (see wiki/Electromotive_force).

New Electromagnetism returns to the ancient tradition of delineating energy into Potential and Kinetic forms. This distinction is present in Maxwell's texts where it is claimed that an electric field stores potential energy and a magnetic field stores kinetic; however, this information was somehow forgotten when Maxwell developed the plane wave equation. This knowledge would have yielded a quadrature model which is normal for waves that propagate over a medium. The solution to Maxwell's dilemma is found later in this section.

Modern text books make no mention of kinetic or potential with regard to field energy. The only remnant of such distinction is the "emf" shown in Faraday's model (classical texts would use the term "law" which is hubris).

The "emf" in Faraday's model is joules per coulomb; however, it cannot be potential joules, otherwise it would be in violation of Kirchhoff's voltage "law" because potential voltage is conservative and cannot add energy to a closed loop. Thus, emf can only be kinetic energy per coulomb and Maxwell's version of Faraday's Model (Equation 1-1) needs revision as does the derivation of the plane wave equation. The revised radiation model would be a quadrature model. The quadrature nature eliminates the violation of conservation of energy problem that physicists do not seem to care about. Furthermore, the quadrature nature is shared by all other wave phenomenon including the actual radio wave models used by electrical engineers. Physicist should have questioned why Maxwell's Plane wave equation was the ONLY exception to the quadrature nature of wave mechanics.

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

Equation 1-1: Maxwell's Version of Faraday's Model

This section introduces a new unit for emf (kinetic energy per coulomb) called Vim. The distinction between Vim and Volts is highlighted in the following subchapters.

1.5.1 Voltage -- Volts

Voltage is defined as potential energy per coulomb. The field mechanism responsible for voltage is conservative which means that it obeys Kirchhoff's Voltage Law and thus cannot add energy to a closed path. This means that a closed loop of wire in a conservative field always produces zero volts. Other legacy terms such as Potential or Potential difference are allowed. The unit of Voltage is the volt (plural form is volts) which is joules per coulomb. In natural units, this reduces to charge acceleration (coulomb meter per second per second).

1.5.2 Vimage -- Vim

Vimage is defined as kinetic energy per coulomb. The fields responsible for vimage are non-conservative which means that a closed coil of wire in such a field can acquire energy (Vim). This allows Vimage to be increased by adding turns of wire to the coil. Vimage is derived from the word vim which is synonymous with vigor, energy. The unit of Vimage is the vim (plural form is also vim). The symbol Vim or vim may also be used as a variable name as long as the contents are vimage.

Although vim and volts are both joules per coulomb, it is necessary to have different units to distinguish that vim is kinetic and volt is potential which means they are orthogonal. Be advised that older documents by this author may use the symbol V_K or emf for kinetic voltage with the units of legacy volts. There are presently no plans for retrofitting the older papers.

1.5.3 The relationship between Vimage and Voltage

The relationship between vimage and voltage in a wire is directly analogous to the kinetic energy and potential energy in a pendulum. As long as there are no significant impedances, the energies will exchange. An example of vimage and voltage is given in Figure 1-4. The Figure shows a barbell shaped conductor in two states (A, B). Prior to state A or state B (the initial state), the barbell contains evenly distributed mobile carriers (blue). In state A, a non-conservative field (RED) is coupled which imparts kinetic energy to the mobile carriers. The mobiles carriers then displace, converting their kinetic energy to potential energy in the form of a coulomb field (BLUE) shown in state B. If there is no significant resistance or reactance, then the voltage resulting from the displaced charges will equal the magnitude of the vimage that was absorbed. Note that the field directions are opposite.

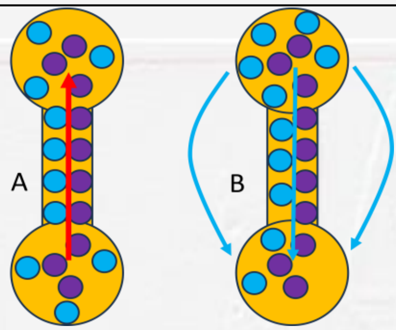


Figure 1-4: Vimage-Voltage Relationship

If the bar were formed into and almost closed loop (Figure 1-5), the experiment resembles the thought experiment used by Maxwell to develop his version of Faraday's Model. The A and B states are overlaid in the diagram for simplicity. The Voltage and Vimage are in opposite directions within the body of the wire; however, across the gap the voltage and vimage are in the SAME directions. And this explains the error in Maxwell's version of Faraday's Model. Although the Voltage across the gap and the Vimage are in the same direction, they do not occur at the same time. A resonant frequency applied to the ring would show that the vimage and the voltage to be in quadrature, not in synchronicity as Maxwell's displacement current analogy.

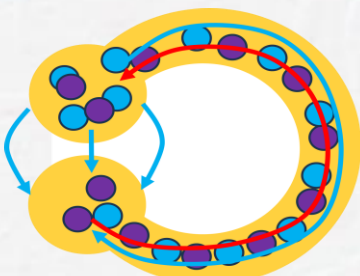


Figure 1-5: Maxwell's Thought Experiment

Simple Vim Measurements

For simple experimental applications, as long as there are no significant resistance and/or reactance (far away from the resonant frequency), the vim coupled to the wire will convert to a voltage that can be measured by voltmeter or oscilloscope. If significant impedances exist, see next section.

1.5.4 Measuring Vim

For the purpose of schematic representation, the vim induced in a loop of wire is lumped together and represented as a "Voltage" source. This is the same electrical engineering technique used when modeling the energy induced in the secondary of a transformer. In electrical engineering, the "voltage" induced in the secondary is the time derivative of the current in the primary multiplied by a coupling constant. This secondary "voltage" is actually vimage. As described previously, if there is no significant impedances or loads, the vimage converts to voltage with no perceptible loss or lag.

The exact same techniques apply to all situations where electromagnetic fields couple energy to conductors. For example, the no-load voltage measured by a probe on the loop of wire (Figure 1-6) sees the coupled vimage directly as voltage for low frequency measurements. The lag and loss increase with frequency as the reactance of the wire and the reactance of the probe increase.

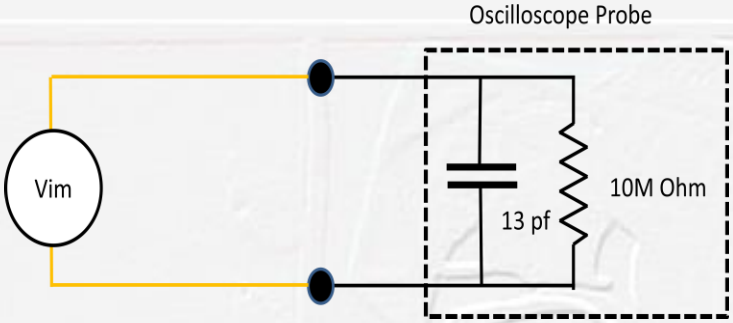


Figure 1-6: Measuring Vim: Negligible Load

More complex cases involve significant impedances in the vim producing loop and/or significant load on the vim producing loop (see Figure 1-7).

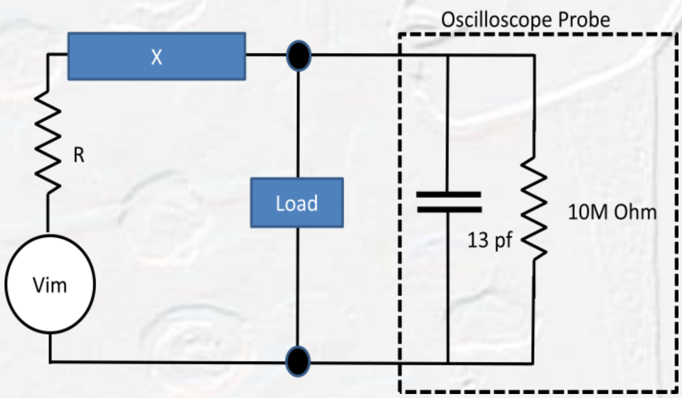


Figure 1-7: Measuring Vimage under load

Again, the techniques used in modeling the secondary of a transformer are employed. The vim producing loop is the secondary where the vim is treated as a simple lumped parameter voltage source (the circle at lower left of Figure 1-7). From there, the resistance and/or impedances of the loop are lumped in (R and X in Figure 1-7). The diagram only shows series resistance and reactance for simplicity; however, applications may require consideration of parallel effects as well.

The mathematics and analysis of such circuits are well covered in engineering texts; therefore, unnecessary to explain here.

1.6 Fields

Pretons are the only charge carrying constructs in Ethereal Mechanics (at this time). The pretonic field and the gravitational field are the only true fields in Ethereal Mechanics (at this time) and the behavior of the preton is responsible for both (see Electrogravity). Other fields of Ethereal Mechanics are synthesized from the true fields. For example, the time derivative of the pretonic field yields the inertial and magnetic forces which are also called fields (due to tradition) even though they are synthetic in nature. The term “field” is defined in Ethereal Mechanics as a state of the medium (ether).

Multiple pretons can work together to form higher order stable constructs that are collectively called systems of pretons or (SOPs). Electrons, Protons, Neutrons, Quarks, and others are synthesized from systems of pretons just as images are synthesized from pixels.

Just as higher order forms of matter are synthesized from the behavior of pretons, so too are higher forms of fields. As pretons counter orbit each other to form a SOP, their magnetic and inertial fields interweave to form very complex force and torque field constructs.

Most of these derivative field constructs diminish with the inverse cube of distance or faster and are called "near-field" effects. This paper is only concerned with "far-field" effects which are applicable to electrical engineering. A number of different derivative field structures summed together and viewed in the far-field synthesize the electric field (A.K.A. Coulomb field). The Electric Force model (Equation 2-1) of NEV5 is the simplified form (an abstraction) of those amalgamated fields (see Electrogravity).

The discussion of the Electric Force model is continued in the next section and section 2.1.

1.7 Coulombic Systems

A Coulombic System is a system of pretons that "express" an electric force as given by the Electric Force model (Equation 2-1). The main reason for this distinction is that the Electric Force field is summation of complex fields generated by a system of pretons COMBINED WITH the coupled effects to another system of pretons. The final Electric Force model is relatively simple because of cancelation of terms. Again, the Electric Force Model is a simplified abstraction of the complex amalgamation of coupling between two systems of pretons. It is not directly applicable to pretonic charge.

The effect of a system of pretons on a lone preton or visa-versa can be determined by following the procedures from Electrogravity; however, those types of interactions are not a significant part of the electrical engineering context of this paper.

Again, because the Electric Force model (Equation 2-1) is the consolidated effect between Systems of Pretons, it is not applicable to individual pretons. The systems of pretons that express the electric force are called Coulombic Systems. The net pretonic charge of the Coulombic System is called the Coulombic Pretonic Charge or more succinctly the Coulombic Charge. The coulombic charge is the value entered into the Electric Force Model (Equation 2-1) for either the source or target charge. The Coulombic charge is essentially the NET pretonic charge of a coulombic system expressed in Coulombs (see section 1.8).

The term Coulombic Charge is used interchangeably to refer to either the Coulombic System or the Pretonic Charge of a Coulombic system.

The lower case q in the models specifies coulombic charge only. The uppercase Q in the models specifies either pretonic of coulombic charge.

The Inertial and Magnetic force models (Equation 2-2, Equation 2-3) specify charge with an upper case Q which means they are applicable to either pretonic or coulombic charge. The charges are intermixable; however, the remainder of this paper is intended for electrical engineering applications where only coulombic systems are discussed. Henceforth, the discussion using the term charge refers to coulombic charge.

1.8 Coulomb

The legacy unit of charge is called the Coulomb. The coulomb is an arbitrary quantity defined before the discovery of the electron when scientists believed that electricity was a continuous fluid. This is the reason for unit charge ($1.602176634 \times 10^{-19}$ Coulombs) being an arbitrary quantity instead of some nice round value. It is important for the reader to be mindful of the distinction between "unit charge" and "unit of charge".

Because coulombic charges are synthesized by systems of pretons, coulomb charge does not actually exist. Because the Coulomb is an arbitrary quantity, it is easily repurposed. It is desirable to express pretonic charge in Coulombs for maximum compatibility with legacy instruments.

There is a nexus between coulombic charge and pretonic charge with regard to the magnetic force. Both produce a magnetic effect when either system is in motion. When a current meter reads 1 ampere, then 1 Coulomb of charge is flowing per second. The charge on a preton is selected to be compatible with the charge of an electron. In Ethereal mechanics, an electron is presently understood to be comprised of two negative pretons for a total of $-1.602176634 \times 10^{-19}$ Coulombs. Therefore, negative pretons comprise -1/2 unit charge for $-8.01088317 \times 10^{-20}$ Coulombs of charge.

Protons are more complex systems comprising 6 positive and 2 negative pretons. This puts the charge on a positive preton at 1/3 unit charge for $5.23058878 \times 10^{-20}$ Coulombs of charge. The net pretonic charge of a proton is therefore $1.602176634 \times 10^{-19}$ Coulombs.

If the models for the Electron and/or Proton change, the charge on negative and/or positive pretons will be adjusted accordingly to maintain compatibility.

1.9 Emission vs. Field

The motion of pretons relative to the medium causes disturbances that propagate away from the point of disturbance. These propagating disturbances are more succinctly called emissions and are the Fields of Ethereal Mechanics. Propagation is always relative to the medium.

The Pretonic Field is an emission resulting from Pretonic motion relative to the medium. The Pretonic field is the basis of the Electric, Magnetic and Inertial Forces. These forces are derivative fields of the Pretonic field.

Another emission is the consumption of the medium. This disturbance also propagates outward as depletion causes successively farther away media flow inward to replace the missing media. This is called depletion propagation and it is the field of gravity (separate from the force of gravity which is the Inertial Force model, see Electrogravity [EM03]).

This is why the pretonic field and the gravitational field are the true fields. Other fields are derivatives or combinations of multiple field effects represented by mathematical abstractions to simplify applications.

These derivatives or abstractions can obscure the emissive nature of the true underlying fields giving the false impression that nature is a collection of static fields as commonly believed by legacy scientific models to include general relativity and classical electromagnetism.

The misidentification of an emission as a static field is easy to visualize. Consider a street light on a slightly foggy night that projects a never changing cone of light throughout the night. If this were the very first time that humans had seen such a phenomenon; it would easily be assumed a static field. With further investigation of the phenomenon of shadows, it would later be recognized as an emission that appears static because of its non-changing nature.

An emission requires a source of energy to draw from just like the street light. The Electrogravity paper demonstrates that the ethereal medium is the fuel that is consumed by matter. A gravitational field is the acceleration of the medium toward the location of depletion. As medium flows inward, the depletion of medium propagates outward. The waste product of ethereal consumption is the emission of the pretonic field and derivatives. The pretonic field causes other pretons to move which further the self sustaining conflagration. The very existence of matter is fueled by ethereal consumption.

Because all field phenomena are either disturbances propagating over the medium or the motion of the medium itself, the concept of a static field is oxymoronic.

The word field is define in Ethereal Mechanics as a region of medium containing disturbances (states) which include (but are not limited to) flow, acceleration, density, depletion, etc. Fields are emissions (which included depletions); however, fields can be derivatives or abstractions which may appear static. The only true static field known at this time is an undisturbed region of space which cannot be measured unless it is disturbed.

1.10 Derived vs. Regressed (empirical)

NEV5 is the first set of electromagnetic models in history derived from a single underlying field model requiring no arbitrary constants of relation (see Electrogravity).

All previous electromagnetic models are empirical in origin, meaning that they were developed from regression of experimental data. The telltales of their empirical origin are the arbitrary constants of relation μ and ε. Until the late 1880s, electricity and magnetism were considered separate effects. Maxwell is credited with unifying electricity with magnetism; however, this is a misnomer because classical electrodynamics is still expressed in terms of two different fields supported by two separate arbitrary constants of relation. It's also very easy to show the many flaws and contradictions in Maxwell's equations; however, such a discussion is of no value since the overwhelming majority of those who defend Maxwell's equations have limited to no working knowledge of the theory; otherwise, Maxwell's equations would have been abandoned more than a century ago.

1.11 Fragmentary Wire Model (FWM)

The Fragmentary Wire Model (FWM) is a wire modeling technique that provides a good tradeoff between accuracy and simplicity. Like the filamentary techniques used in classical text book, the FWM treats a wire as a filamentary thin path in which mobile charges move. Unlike classical models, the FWM makes consideration for the cross section of the conductor (section 1.14) providing higher fidelity. The path is then chopped up into very small lengths (dL) called differential lengths or diminishing lengths that allow a conducting path to be modeled using a path integral. In this text, the differential lengths are referred to as fragments for brevity.

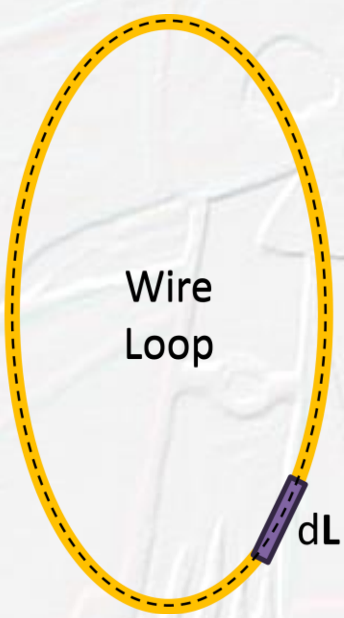


Figure 1-8: Filamentary wire with single fragment highlighted

The derivation of the Fragmentary Wire Model begins by considering an ordinary wire loop consisting of an equal number of positive and negative charges. This is represented by the colored dots in the magnified view of the fragment in Figure 1-9. It is desired to remain charge "agnostic" to allow this modeling scheme to be used with either current convention. This is implemented by not assigning a specific polarity, but stating that the blue charges have the opposite sign as the purples charges. The desired charge polarities and quantities are assigned at application time.

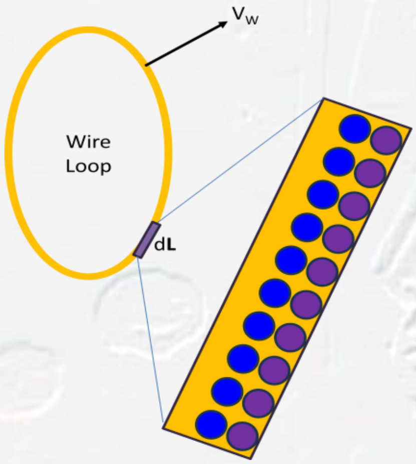


Figure 1-9: Fragment Conduction Modeling

When a current is induced in the wire (Figure 1-10), the mobile carriers represented by light blue dots translate along the wire. The value Q_C represents the total quantity of conduction charge in coulombs (not number of charges). The value V_C represents the velocity of the conduction charge relative to the wire. The value V_W represents the velocity of the wire with respect to the medium. The magenta dots represent uncovered or unbalanced charges with a total charge in coulombs of Q_U. In older documents, the unbalanced charges are called stationary charges; however, the use of the subscript S caused confusion with the subscript S representing the source. Further confusion arose from the fact that the overwhelming quantity of charge in the wire is stationary (purple, dark blue).

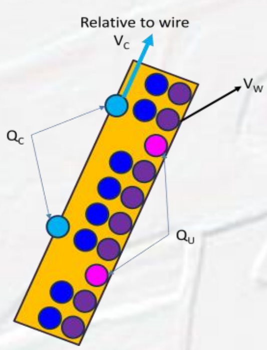


Figure 1-10: Current induced in wire

Because the purple and dark-blue charges are equal and opposite and always move together, they produce no effect that is significant for electrical engineers and are ignored from this point forward.

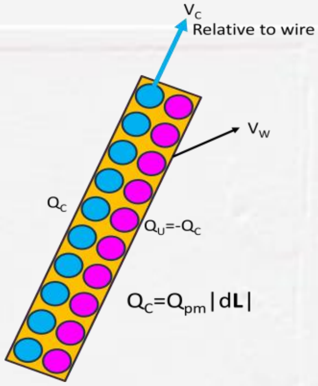


Figure 1-11: Fragmentary Charge Model

Figure 1-11 represents the Fragmentary Charge model used for all derivations going forward. This model omits the balanced charges and just shows the conduction charges (light blue) and the unbalanced charges (magenta).

The remaining sections of this chapter (sections 1.12, 1.13 and 1.14) contain identities and derivations that support the application of the FWM to the Magnetic and Inertial Forces in chapters 3 and Fragmentary Wire Induction4.

Limitations

FWM is not to be used when significant portions of a source and target loop are within a few wire diameters of each other (unless they cross at right angles). This includes all self-induction problems, certain mutual induction problems where the primary (source) and secondary (target) are interlaced, etc. In these cases, solid wire modeling (SWM) is required. Low Frequency Solid Wire Modeling (LFSWM) is found in the Graduate thesis [Thesis] and High Frequency Solid Wire Modeling (HFSWM) is a topic of a supporting paper and software release (TBA).

1.12 The Point-To-Fragment Conversion identity

The point-to-fragment Conversion identity allows the point-charge forms of NEV5 to be converted to wire fragment forms suitable for engineering applications.

Figure 1-12 shows a section of a good conductor of cross-sectional area A, length L, containing a current given by a quantity of mobile charges Q moving at velocity V. The current in the section (I) is found by the following expression

$$I = \frac{QV}{L}$$

Multiplying both sided by L

$$IL = QV$$

The relationship is converted to a vector relationship by realizing that the length of the wire and the velocity of the current are in the same direction. Vectors are identified by bold type face.

$I\mathbf{L} = Q\mathbf{V}$ (**L** and **V** in same directions)

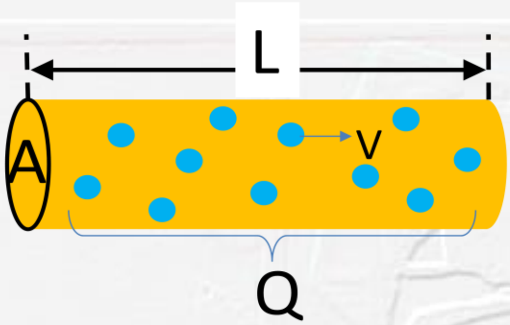


Figure 1-12: Wire Section containing Moving Charge

Path integrals are a convenient way to model the effects of current carrying wires. A path integral divides up the length of an arbitrary wire structure into differential lengths (dL) which are referred to as fragments in this paper and all supporting papers. As the differential length (dL) of the fragments diminish toward zero, so too does the quantity of charge contained in the fragment. This diminishing quantity of charge is represented by dQ. Applying these differential forms result in the point to fragment conversion identity.

$$Id\mathbf{L} = dQ\mathbf{V}$$

Equation 1-2: 1st Order Point-To-Fragment Conversion

To verify this identity, it is written out in differential units form

$$\frac{dQ}{dt}dL = dQ\frac{dL}{dt}$$

To support conductors carrying time varying currents, the time derivative of the 1st order version is taken to obtain the 2nd order identity.

$$\frac{dI}{dt}d\mathbf{L} = dQ\frac{d\mathbf{V}}{dt} = dQ\mathbf{a}$$

Equation 1-3: 2nd Order Point-To-Fragment Conversion Identity

The Deprecated Point-To-Fragment Identity → dQ=Q? confusion

Earlier Papers in Ethereal Mechanics used a less rigorous definition of the point to fragment conversion identity shown in Equation 1-4. The flaw in the older identity is an imbalance of diminishing operators (d, differential operators) which limits the use of the identity to point-charge models where it could be argued that Q and dQ are generally the same thing.

$$Id\mathbf{L} = Q\mathbf{V}$$

Equation 1-4: Deprecated 1ST Order Point-To-Fragment Conversion Identity

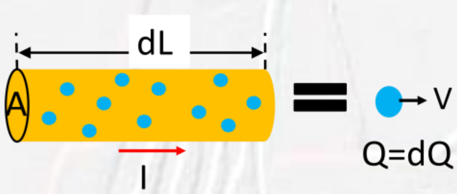


Figure 1-13: Deprecated Point to Fragment

Usage of this identity is deprecated. Which means it should not be used for new derivations while older derivations should be revised when time permits. This deprecated identity mentioned here as a reference to support older derivations and put them into context for those wishing to explore.

The older derivations used the identity correctly which means the imbalance of the diminishing operators was corrected by fiat.

1.13 Point-Force to Fragmentary-Vim Conversion

Electromagnetic fields that exert a force on a point charge can also exert force on the mobile carriers in a conductor resulting in vimage that can be measured with volt-meter or oscilloscope as per section 1.5. The following procedure allows the conversion of Point-Force models or interfragmentary Force models to Fragmentary-Vim models for such purpose.

The force models suitable for this conversion are found in the following forms:

$$\mathbf{F}_T = Q_T(\text{some-expression with } \mathrm{Q_S})$$

$$d\mathbf{F}_T = dQ_T(\text{some-expression with } \mathrm{I_S d}\mathbf{L}_\mathrm{S})$$

In either case, divide both sides by the target charge and dot product both side by the target fragment length

$$dVim = \frac{\mathbf{F}_T}{Q_T} \bullet d\mathbf{L}_T = (\text{some-expression with } \mathrm{Q_S}) \bullet d\mathbf{L}_T$$

$$dVim = \frac{d\mathbf{F}_T}{dQ_T} \bullet d\mathbf{L}_T = (\text{some-expression with } \mathrm{I_S d}\mathbf{L}_\mathrm{S}) \bullet d\mathbf{L}_T$$

The green symbols indicate that this conversion is “agnostic”. When applied to force expressed in legacy units, the resulting vim is legacy units. When applied to natural units, the resulting vim is in natural units.

The ddVim expression is the version encountered most. To resolve it to vim (as opposed to ddVim) a double path integral must be performed which would look something like the following

$$Vim = \int_S \int_T (\text{some-expression with } \mathrm{I_S d}\mathbf{L}_\mathrm{S}) \bullet d\mathbf{L}_T$$

1.14 Conduction Velocity V_C, Charge Density Q_{PM}

Some applications require knowledge of the velocity of the mobile carriers (Conduction Velocity). This includes applications where the conducting path changes in cross section requiring mobile carriers to either speed up or slow down (Venturi Charge motion). In other applications, the conductive path changes to a different material which alters the conduction velocity.

Another application, requiring knowledge of conduction velocity, is the Hall Effect which is covered in section 6.1.

To determine conduction velocity requires the determination of the quantity of mobile charge per unit length (per meter). This value is given the symbol Q_{PM} (Coulomb per meter) and varies by material and cross sectional area of the conduction path. This quantity is determined from basic material properties using the following procedure.

The first step is to compute the number of mobile carriers per unit volume. This is done by going to the wiki page for the desired material. Using Copper as an example, from the wiki/Copper page, the following values are found under the physical and atomic properties sections.

Standard atomic weight 63.546 grams/mole

Electrons per shell = 2,8,18,1

Density (near r.t.)= 8.96 grams/cc (cc= cubic centimeter)

From the "Electrons per shell" only the final number on the right is required. This is the electrons in the outer valence shell. We assign this to the symbol n. The other values are assigned as follows

W= 63.546 grams/mole

n= 1

D= 8.96 grams/cc

Other required constants are Avogadro's number (A_V) and the unit charge (u)

$$A_V = 6.022141 \times 10^{23} \text{ Atoms/mole}$$

$$u = 1.602177 \times 10^{-19} \text{ Coulombs}$$

The quantity of mobile carriers per cubic centimeter is

$$N_{CC} = \frac{nA_V D}{W} = 8.49123x10^{22} \text{ carriers per cc}$$

In the Fizzix2 software, everything is done in terms of meters, so the above is converted to cubic meters

$$N_{M3} = N_{CC} * 1000000 \text{ cc/m3} = 8.49123x10^{28} \text{ carriers per cubic meter}$$

Convert to Coulombs per cubic meter, multiply by unit charge

$$Q_{M3} = uN_{M3} = 1.3604x10^{10} \text{ coulombs per cubic meter}$$

Material	Resistance ohm-m	N_{M3} Carriers per m^3	Q_{M3} Coulombs per m^3
Copper	1.72e-8	8.491e+28	1.360e+10
Gold	2.44e-8	5.901e+28	9.454e+9
Silver	1.59e-8	5.856e+28	9.383e+9

Table 1-1: Conduction Properties of selected metals

The above table shows the computed values for a small selection of metals as an example. Also included in the table is the resistance of the metals in ohm-meters which is used elsewhere.

The value Q_{M3} is also used in the Hall Effect example in section 6.1 as well as solid wire modeling which is the subject of a different paper.

For Fragmentary wire modeling Q_{M3} is used to compute the mobile charge per unit length (Q_{PM}) using the following relationship.

$$Q_{PM} = AQ_{M3} \text{ coulombs per meter}$$

Equation 1-5: Mobile Carriers per Unit Length

The variable A is the cross sectional area of the wire being used. The following tables list a few values of Q_{PM} for different gauges of copper wire.

Gauge	Diameter (m)	Area A (m^2)	Q_{PM} (coulombs per meter)
30	0.0002540	5.067e-8	6.891e+2
24	0.0005015	2.047e-7	2.784e+3
22	0.0006426	3.243e-7	4.410e+3
18	0.0010236	8.229e-7	1.119e+4

Table 1-2: Q_{PM} for Copper Wire

The value Q_{PM} is the quantity of mobile charge in Coulombs per meter (see section 1.11). To find the total conduction charge in a fragment, the length of the fragment (dL) is multiplied by Q_{PM} for the material being modeled.

The conduction charge of a differential length of fragmentary conductor is

$$dQ_C = |d\mathbf{L}| Q_{PM} \text{ coulombs}$$

Equation 1-6: Fragmentary Conduction Charge

Substituting this into Equation 1-2 for dQ yields

$$Id\mathbf{L} = |d\mathbf{L}| Q_{PM} \mathbf{V}$$

Then solve for V yields the conduction velocity (V_C)

$$\mathbf{V}_C = \frac{Id\mathbf{L}}{|d\mathbf{L}| Q_{PM}} = \frac{I}{Q_{PM}} d\hat{\mathbf{L}}$$

Equation 1-7: Fragmentary Conduction Velocity

Note: The conduction velocity V_C is relative to the wire.

Later chapters demonstrate the application of V_C and Q_{PM} to the FWM.

2 The Models

The following are the New Electromagnetism V5 Models shown in point charge form. Later sections apply these models to various experimental constructs. These models are derived from the Pretonic field in the Electrogravity Paper [EM03]. These equations have no arbitrary constants of relation (ACOR) because they are expressed in Natural Units (NU) as described in 1.2.

$$\mathbf{F}_T = q_S q_T (C^2 - V_{qs}{}^2)\frac{\hat{\mathbf{r}}}{|\mathbf{r}|^2} \quad \text{(Conservative, abstract field)}$$

Equation 2-1: Electric Force Model. A.K.A. New Coulomb

$$\mathbf{F}_T = Q_S Q_T \frac{[\mathbf{V}_S / \hat{\mathbf{r}}](\mathbf{V}_T - \mathbf{V}_S)}{|\mathbf{r}|^2} \quad \text{(Non-Conservative, derivative field)}$$

Equation 2-2: Magnetic Force Model. A.K.A. New Magnetism

The magnetic force model may be expressed in the following variations in other papers or applications

$$\mathbf{F}_T = Q_S Q_T \frac{[\hat{\mathbf{r}}\mathbf{V}_S](\mathbf{V}_T - \mathbf{V}_S)}{|\mathbf{r}|^2} = Q_S Q_T \frac{[\mathbf{V}_S / \mathbf{r}](\mathbf{V}_T - \mathbf{V}_S)}{|\mathbf{r}|}$$

$$\mathbf{F}_T = -Q_S Q_T \frac{\mathbf{a}_S}{|\mathbf{r}|} \quad \text{(Non-Conservative, derivative field)}$$

Equation 2-3: Inertial Force Model. A.K.A. New Induction

In the above equations, C is the only constant and its value is the speed of light.

Subscript S represents quantities related to the source charge that is emitting/generating the field/effect. Subscript T represents quantities related to the target charge which is reacting to the field/effect.

Essentially the target reacts to the source.

Upper case Q represents a quantity of charge that could either be pretonic or coulombic (see section 1.7). Because this document is focused on electrical engineering applications, only coulombic charges are considered. For pretonic applications see Electrogravity [EM03].

Lower case q represents quantities of charge that are ONLY coulombic. The reason is that the Electric Force model is the combined effect of the force generated by the behavior of pretons inside the source coulombic system and the effects coupled to the pretons in the target coulombic system. The behaviors of the pretons in the target system affect the aggregate of the force on target as a whole. Therefore, this model is a simplification/abstraction of a much more complicated series of interactions among two systems of pretons. This discussion is continued in section 2.1.

The use of the word "charge" from this point forward is assumed to be coulombic charge unless specified otherwise.

F_T is the force affecting the target charge.

V_S is the velocity of the source charge with respect to the medium.

V_T is the velocity of the target charge with respect to the medium.

a_S is the acceleration of the source charge with respect to the medium.

r is the vector distance from the source charge to the target charge which is computed by subtracting the vector position of the source ($\mathbf{P}_S$) from the position of the target ($\mathbf{P}_T$).

$$\mathbf{r} = \mathbf{P}_T - \mathbf{P}_S$$
$$\dot{\mathbf{r}} = \mathbf{V}_T - \mathbf{V}_S$$

Bold type face represents Vortrix vector quantities.

Multiply any of the above equations by K_M to convert to legacy force (section 1.2).

Expanded details of the models are found in the following sections.

2.1 The Electric Force Model

Equation 2-1 is the Electric Force Model. This effect is synthesized from the Magnetic and Inertial Forces generated by the behavior of the pretons in a source coulombic system. The coupling of the effect to a target Coulombic system is affected by the behavior of the internal pretons of the target. The model reduces all the effects to a simple abstract equation for ease of application. The derivation of the model is found in Electrogravity [EM03].

It should be noted that the interactions between systems of pretons (SOPs) are highly complex showing many modes of coupling that include torques as well as forces. Most of these effects exist when SOPs are in close proximity to each other and are considered near-field effects (less than 100 diameters of the coulombic system--approximate). Near-field effects govern the structure of matter and are not significant for electrical engineering applications. The Electric Force effect is meaningful at the electrical engineering scale and is this called a far-field effect.

This model supersedes the legacy Electric field model (A.K.A Coulomb's "Law"). This model behaves identically to the legacy model except for the inherent compensation (C^2-V^2) for Transvariant effects. This effect would be referred to as "Time Dilation" by members of the Relativity community (MORCs). Time Dilation is a misnomer since Ethereal Mechanics demonstrates that it's the material processes that slow, not the passage of time. Relativity does not provide a model of matter and therefore cannot causally demonstrate how ANY relativistic effect manifests. MORCs apply "Time Dilation" and "Length Contraction" Ad Hoc to Newtonian mechanics resulting in a comedy of paradoxes such as the Ladder Paradox.

This paper will not cover engineering applications of the Electric Force model since it is not materially different from that found in legacy texts. Legacy texts are adequate for the present time.

For compatibility with legacy texts and measuring instruments, multiply by K_M to convert to legacy units.

$$\mathbf{F}_T = K_M q_S q_T (C^2 - V_{qs}{}^2) \frac{\hat{\mathbf{r}}}{|\mathbf{r}|^2}$$

Equation 2-4: Electric Force Model, Legacy Units (LU)

A future Ethereal Mechanics supplement for the Electric force model will be developed for completeness.

2.2 The Inertial Force Model

Equation 2-3 is the Inertial Force model. The Inertial Force is responsible for inductance, force of inertia, the force of gravity (not the field of gravity). In a later supplement it is shown to be the primary component of electromagnetic radiation. The model is developed from the time derivative of the Pretonic field (See Electrogravity).

The Inertial Force model was original developed by regression of experimental data in the mid 1990s and called New Induction (see Foundation playlist [FOUND]).

$$\mathbf{F}_T = -K_M \frac{Q_S Q_T}{r} \mathbf{a}_S$$

Equation 2-5: Inertial Force Model in Legacy Units and Legacy vector format

From the beginning, it was obvious that the model expressed a structure for matter. Consider the inertial force (or reactionary force) from an object of inertia M (in Kilograms) being accelerated by an applied force.

$$\mathbf{F} = -M\mathbf{a}$$

Equation 2-6: Inertial force

Notice what happens when Equation 2-6 and Equation 2-5 are set equal to each other and solved for M

$$M = K_M \frac{Q_S Q_T}{r} \quad (Kg)$$

By substituting the unit charge for Q and the classical electron radius for r; results in the exact match for the “mass” of an electron in kilograms.

This is what began Ethereal Mechanics over 25 years ago. It was a short trip to a model of matter based on “massless” charged particles and a gravity theory based on a medium accelerating toward massive bodies. See Electrogravity [EM03] for the most up-to-date models in NEV5. For the original venture down the rabbit hole see the paper New Gravity from 1999 [NG]. It is written in older notation and language and was the transitional paper from NEV1/NEV2 to NEV3.

2.3 The Magnetic Force Model

Equation 2-2 is the Magnetic Force Model. The Magnetic Force is developed from the time derivative of the pretonic field (see Electrogravity). As stated previously, the magnetic force model is radically different from previous New Electromagnetism versions and classical theory.

The magnetic force model is responsible for first order (Velocity) effects which produce Force and/or Vim between current carrying coils. This also includes magnets which are modeled as current carrying coils (without Centripetal or Venturi components).

The remainder of this paper demonstrates applications of this model with regard to common electrical engineering problems.

Great care must be taken when applying the Magnetic force to conductors. The effects of ALL charges must be accounted for to properly model magnetism. This is demonstrated in following chapters.

3 Fragmentary Wire Magnetism

This section applies the Magnetic Force model to Fragmentary Wire Model (section 1.11) to develop useful relationships for simulation of effects between current carrying constructs such as wires and magnets.

These models are combined with the Fragmentary Wire Induction models from Section 4 for a complete accounting of effects. This demonstrated in section 5 (Advanced Models) and onward.

These models are limited to low frequency applications. High frequency applications are the topic of a supplemental application paper.

3.1.1 Magnetic Force: Fragment to Point

The first derivation considers the magnetic force from a source fragment to an arbitrary charge (green) some distance away.

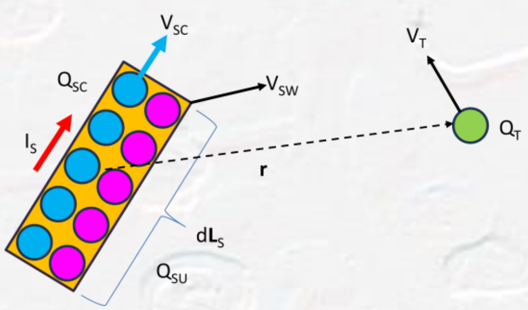


Figure 3-1: Fragment to Point Parameterization

The first step is to compute the effects from the source conduction charges (blue) on the target (green). Since the conduction velocity (V_{SC}) is relative to the wire, the total source velocity (V_S) of the conduction charges is the combination of the source conduction velocity (V_{SC}) and the velocity of the wire fragment (V_{SW}). Substituting the total source velocity and conduction charge in to Equation 2-2

$$\mathbf{F}_{TC} = Q_{SC} Q_T \frac{\left[(\mathbf{V}_{SC} + \mathbf{V}_{SW}) / \hat{\mathbf{r}} \right] \left(\mathbf{V}_T - \mathbf{V}_{SC} - \mathbf{V}_{SW} \right)}{|\mathbf{r}|^2}$$

The V_{SC} term highlighted in red represents an anomaly. For all applications except interfragmentary Vim (explained later), the effects of this term cancel. Furthermore, the original derivation of the Magnetic Force model (Electrogravity [EM03]) shows that the contents of the parenthesis (containing the anomaly) are the time derivative of **r**; which according to Figure 3-1 should only be ($\mathbf{V}_T$-$\mathbf{V}_{SW}$). Another argument is that the fragment is part of a larger wire loop, as conduction charge exit the fragment at the top, they are replaced by charges entering at the bottom; therefore, the center-of-charge of the fragment relative to the target is not affected by VSC leaving only ($\mathbf{V}_T$-$\mathbf{V}_{SW}$) as the representation of the change in distance between the two systems. Finally, experimental results of interfragmentary Vim agree with discarding this term. Therefore, the short term resolution is to eliminate the term. The long term solution is found in Appendix D.

V_{SC} remains in the other part of the equation because the Pretonic field (from which this is derived) is generated by charge motion relative to the medium; therefore, it is independent of the closing/opening rate of the two systems ($\mathbf{V}_T$-$\mathbf{V}_{SW}$).

Next, the Magnetic force model resulting from the uncovered/unbalanced charges (magenta) is considered.

$$\mathbf{F}_{TU} = Q_{SU} Q_T \frac{\left[(\mathbf{V}_{SW}) / \hat{\mathbf{r}} \right] \left(\mathbf{V}_T - \mathbf{V}_{SW} \right)}{|\mathbf{r}|^2}$$

Remembering that $Q_{SU} = -Q_{SC}$, the above two expressions are combined to express the total force on the target

$$\mathbf{F}_T = Q_{SC} Q_T \left(\frac{\left[(\mathbf{V}_{SC} + \mathbf{V}_{SW}) / \hat{\mathbf{r}} \right] \left(\mathbf{V}_T - \mathbf{V}_{SW} \right)}{|\mathbf{r}|^2} - \frac{\left[(\mathbf{V}_{SW}) / \hat{\mathbf{r}} \right] \left(\mathbf{V}_T - \mathbf{V}_{SW} \right)}{|\mathbf{r}|^2} \right)$$

This reduces as follows

$$\mathbf{F}_T = Q_{SC} Q_T \left(\frac{\left[(\mathbf{V}_{SC}) / \hat{\mathbf{r}} \right] \left(\mathbf{V}_T - \mathbf{V}_{SW} \right)}{|\mathbf{r}|^2} \right)$$

Next, determine the quantity of conduction charge in the source fragment

$$dQ_{SC} = Q_{SPM} \left| d\mathbf{L}_S \right|$$

Substitute that into the Point-To-Fragment conversion identity and solve for the conduction velocity

$$\mathbf{V}_{SC} = \frac{I_S d\mathbf{L}_S}{dQ_{SC}} = \frac{I_S d\mathbf{L}_S}{Q_{SPM} \left| d\mathbf{L}_S \right|} = \frac{I_S d\hat{\mathbf{L}}_S}{Q_{SPM}}$$

Then substitute back into the main equations to arrive at the final expression. This is the Magnetic force from a Fragment to a Point Charge (F-P).

$$d\mathbf{F}_T = Q_T I_S \left(\frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}} \right] \left(\mathbf{V}_T - \mathbf{V}_{SW} \right)}{|\mathbf{r}|^2} \right)$$

Equation 3-1: Magnetic Force F-P

The equation is a fragmentary equation which requires integration over a source loop to find to the total force.

3.1.2 Magnetic Force: Fragment to Fragment

This section develops the expression for force between two fragments. This is generally referred to as interfragmentary force. More specifically, it is the interfragmentary magnetic force.

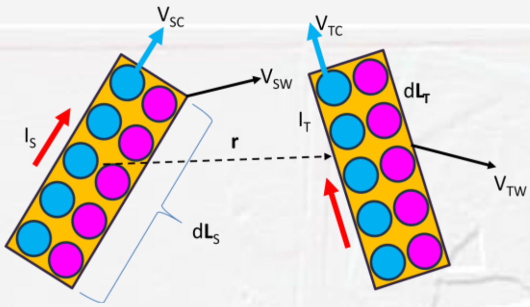


Figure 3-2: Fragment to Fragment Parameterization

Equation 3-1 already defines the Fragment-to-Point magnetic force for a source fragment. To find the force on a target fragment, Equation 3-1 is first applied to the conduction charges in the target and then to the unbalanced charge in the target and the effects are then summed to determine the total force acting on the target fragment from the source fragment.

The first step is to determine the conduction charges in the target fragment using the techniques described in section 1.14.

$$dQ_{TC} = Q_{TPM}\left|d\mathbf{L}_T\right|$$

Then substitute into the Point-To-Fragment conversion identity solve for the target conduction velocity

$$\mathbf{V}_{TC} = \frac{I_T d\mathbf{L}_T}{dQ_{TC}} = \frac{I_T d\mathbf{L}_T}{Q_{TPM}\left|d\mathbf{L}_T\right|} = \frac{I_T d\hat{\mathbf{L}}_T}{Q_{TPM}}$$

Substitute into Equation 3-1 for the target conduction charges

$$dd\mathbf{F}_{TC} = Q_{TPM}\left|d\mathbf{L}_T\right| I_S \left(\frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right]\left(\frac{I_T d\mathbf{L}_T}{Q_{TPM}\left|d\mathbf{L}_T\right|} + \mathbf{V}_{TW} - \mathbf{V}_{SW}\right)}{\left|\mathbf{r}\right|^2}\right)$$

Then use Equation 3-1 to determine the effect on the uncovered/unbalanced charges

$$dd\mathbf{F}_{TU} = -Q_{TPM}\left|d\mathbf{L}_T\right| I_S \left(\frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW} - \mathbf{V}_{SW}\right)}{\left|\mathbf{r}\right|^2}\right)$$

Sum the two above expression to determine the total force acting on the target fragment

$$dd\mathbf{F}_T = dd\mathbf{F}_{TC} + dd\mathbf{F}_{TU} = Q_{TPM}\left|d\mathbf{L}_T\right| I_S \left(\frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right]\left(\frac{I_T d\mathbf{L}_T}{Q_{TPM}\left|d\mathbf{L}_T\right|}\right)}{\left|\mathbf{r}\right|^2}\right)$$

This reduces to

$$dd\mathbf{F}_T = I_S I_T \frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right] d\mathbf{L}_T}{|\mathbf{r}|^2}$$

Equation 3-2: Magnetic Force F-F

This is the interfragmentary (F-F) Magnetic force model. To find the total force, a dual path integral must be performed. The fizzix2 Software can numerically determine inter-loop forces.

3.1.3 Magnetic Vim: Fragment to Fragment

This section develops the expression for vim developed in a target fragment resulting from a source fragment. This is generally referred to as interfragmentary vim. More specifically, it is the interfragmentary magnetic vim.

In this derivation, Equation 3-1 is applied only to the conduction charges in the target as shown in Figure 3-3.

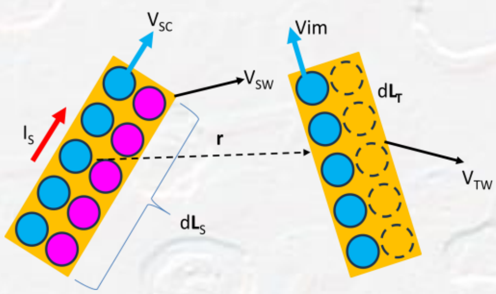


Figure 3-3: Fragment to Vim Parameterization

The first step is to determine the conduction charges in the target fragment using the techniques described in section 1.14.

$$dQ_{TC} = Q_{TPM} \left| d\mathbf{L}_T \right|$$

Then substitute into the Point-To-Fragment conversion identity solve for the target conduction velocity

$$\mathbf{V}_{TC} = \frac{I_T d\mathbf{L}_T}{dQ_{TC}} = \frac{I_T d\mathbf{L}_T}{Q_{TPM} \left| d\mathbf{L}_T \right|} = \frac{I_T d\hat{\mathbf{L}}_T}{Q_{TPM}}$$

Substitute into Equation 3-1 for the target conduction charges

$$dd\mathbf{F}_{TC} = Q_{TPM} \left| d\mathbf{L}_T \right| I_S \left(\frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right] \left(\frac{I_T d\mathbf{L}_T}{Q_{TPM} \left| d\mathbf{L}_T \right|} + \mathbf{V}_{TW} - \mathbf{V}_{SW} \right)}{|\mathbf{r}|^2} \right)$$

The above reduces as follows

$$dd\mathbf{F}_{TC} = I_T I_S \frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right] d\mathbf{L}_T}{|\mathbf{r}|^2} + Q_{TPM} \left| d\mathbf{L}_T \right| I_S \frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right] \left(\mathbf{V}_{TW} - \mathbf{V}_{SW} \right)}{|\mathbf{r}|^2}$$

The green portion of the above equation represents the same force component found in Equation 3-2. It is also responsible for the Hall Effect which is discussed in Section 6.1. It is being highlighted in green to demonstrate a CRITICAL difference between Vortrix Algebra and legacy vector algebra that needs to be understood for those who wish success using Vortrix Algebra.

The next step is to convert this to a vim expression by following the procedure outline in section 1.13. First divide both sides by the conduction charge.

$$dQ_{TC} = Q_{TPM}\left|d\mathbf{L}_T\right|$$

Resulting in

$$\frac{dd\mathbf{F}_{TC}}{dQ_{TC}} = \frac{1}{Q_{TPM}} I_T I_S \frac{\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]d\hat{\mathbf{L}}_T}{|\mathbf{r}|^2} + I_S\frac{\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW}-\mathbf{V}_{SW}\right)}{|\mathbf{r}|^2}$$

The dot product both sides by the target fragment

$$ddVim_T = \frac{dd\mathbf{F}_{TC}}{dQ_{TC}}\bullet d\mathbf{L}_T = \frac{I_T I_S}{Q_{TPM}}\left(\frac{\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]d\hat{\mathbf{L}}_T}{|\mathbf{r}|^2}\right)\bullet d\mathbf{L}_T + I_S\left(\frac{\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW}-\mathbf{V}_{SW}\right)}{|\mathbf{r}|^2}\right)\bullet d\mathbf{L}_T$$

First, it is important to do this conversion step-by-step to keep proper accounting of the differential operators (d) to attribute to the left side.

Second, the green $d\mathbf{L}_T$ might confuse people into believing that a triple integral is required to resolve the first term; however, the green $d\mathbf{L}_T$ is a direction vector of the diminishing length; therefore, it does not limit to zero length (diminish) requiring integration. One may conclude that both dL_T values could be combined to dispel the confusion; however, Vortrix algebra does not have the lax rules of other mathematical tools, order of operation is important. This is the subject of the next paragraph.

Thirdly, parentheses are added to ensure the products are executed in the proper order. Vortrix Algebra is a more fundamental form of mathematics because it is less ambiguous rules than previous mathematical tools. For example, Vortrix products must occur in the order that they are applied. And the judicious use of parentheses is employed to ensure order of execution. For example, the matrices $[dL_S/r]$ must rotate the items inside the parentheses in order to put them into the correct special orientation to then be the subject of the dot product. If legacy vector algebraic rules were followed, it would be normal to simplify the expression by applying the dot product of $d\mathbf{L}_T$ to arrive at

$$ddVim_T = \frac{I_T I_S}{Q_{TPM}}\frac{\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]}{|\mathbf{r}|^2}\left|d\mathbf{L}_T\right| + I_S\frac{\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW}\bullet d\mathbf{L}_T-\mathbf{V}_{SW}\bullet d\mathbf{L}_T\right)}{|\mathbf{r}|^2}$$

Equation 3-3: DO NOT USE FOR ANYTHING

Because the dot products reduce the vectors to scalars, the matrices cannot perform rotation on a scalar and the resulting answer is invalid.

Now that the importance of the order of vector products has been demonstrated, the main derivation can continue. Although the dot product must follow order of products because it is a vector, the scalars in the equations are not so restricted; they follow the same rules as legacy products. This realization plus some other allowed reconfigurations, the equation can be simplified as follows:

$$ddVim_T = \frac{I_S}{|\mathbf{r}|^2}\left(\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW} - \mathbf{V}_{SW} + \frac{I_T}{Q_{TPM}} d\hat{\mathbf{L}}_T\right)\right) \bullet d\mathbf{L}_T$$

Equation 3-4: Total Magnetic Vim F-F

Most of the time, when using a conductor to measure the vim resulting from magnets in motion, the target fragment is not energized with a current (I_T=0). Setting target current to zero results in the more widely used expression.

$$ddVim_T = I_S\left(\frac{\left[d\mathbf{L}_S / \hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW} - \mathbf{V}_{SW}\right)}{|\mathbf{r}|^2}\right) \bullet d\mathbf{L}_T$$

Equation 3-5: Magnetic Vim F-F

The above equation is the interfragmentary vim equation which is used in the simulation of the Paradox experiments shown in sections 7 and 8.

4 Fragmentary Wire Induction

Successful application of NEV5 requires complete accounting of charge behavior in various media. There are two general classes of charge motion to be investigated, 1st order and 2nd order. The 1st order behaviors are fewer, but more complex, and covered in Section 3 (Fragmentary Wire Magnetism). The 2nd order effects are simpler but more numerous. The 2nd order effects are based on 2nd order time derivatives of charge position and charge quantity. The 2nd order time derivative of charge position is charge acceleration while the 2nd order time derivative of charge quantity is time varying current.

These charge motion effects are combined in section 5 with those from Section 3 to develop complete expression for interfragmentary coupling. These couplings are demonstrated experimentally in Section 7.

Note: Solid Wire Modeling (SWM) of these effects are found in a separate supporting paper.

4.1 Inductance (Time Varying Current)

This section develops the interfragmentary models containing time varying currents which are collectively known as induction.

Begin by substituting Equation 1-3 (2nd Order Point-To-Fragment Conversion Identity) into Equation 2-3 (Inertial Force Model. A.K.A. New Induction)

$$d\mathbf{F}_T = -Q_T \frac{dI_S}{dt} \frac{d\mathbf{L}_S}{|\mathbf{r}|}$$

Equation 4-1: Induction Inertial Force F-P

The above is the force on a target charge (Q_T) due to current change in a source fragment (dL_S).

Next, the process in section 1.13 is applied to convert the point force into fragmentary vimage. First divide both sides by (Q_T), then apply dot product of target fragment

$$\frac{d\mathbf{F}_T}{Q_T} \bullet d\mathbf{L}_T = -\frac{dI_S}{dt} \frac{d\mathbf{L}_S \bullet d\mathbf{L}_T}{|\mathbf{r}|}$$

Because there are two diminishing operators remaining in the numerator on the left, the resulting vim will have 2 operators

$$ddVim_T = -\frac{dI_S}{dt} \frac{d\mathbf{L}_S \bullet d\mathbf{L}_T}{|\mathbf{r}|}$$

Equation 4-2: Induction Inertial Vim F-F

To determine the vim coupled between a source and target wire, Equation 4-2 is integrated over the path of the source wire and target wire which is expressed as:

$$vim_T = -\frac{dI_S}{dt} \int_S \int_T \frac{d\mathbf{L}_S \bullet d\mathbf{L}_T}{|\mathbf{r}|} \quad \{\text{for r >> wire diameter}\}$$

Equation 4-3: Induction Inertial Vim W-W

The use and limitations of these models are described in the following sections.

The above equation looks similar to the Neumann equation of classical theory except for the fact that the Neumann equation is constrained to closed path integrals. This is because it is derived from vector magnetic potential which require close path integrals otherwise the result is meaningless [HAYT]. The new models are free of these constraints because they are derived from the pretonic field which is a spherical field model as opposed to the toroidal shape of the Biot-Savart (BS) field model. This allows the ability to determine the vim in any section of a loop resulting from any section of a source loop even if the sections are collinear as shown in Figure 4-1.

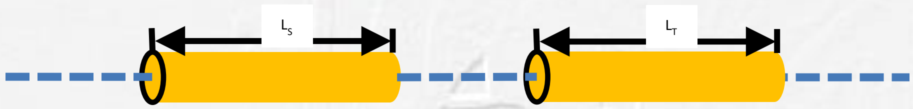


Figure 4-1: coaxial wire sections

Classical Theory does not produce results for the above problem because the BS model shows no field energy longitudinally to a wire section; therefore, no coupling can occur. Furthermore, the entire body of classical induction is based on the notion of enclosed flux lines which is indeterminable if the integral path is not closed; therefore, the discussion of interfragmentary effects is not even approachable.

4.1.1 Mutual Inductance

Mutual Inductance occurs when the time-changing current in a wire (source) couples energy to a separate wire (target). An example of a mutual inductor is a transformer.

Equation 4-2 and Equation 4-3 are suitable for mutual inductive coupling between separate wire structure in free space at low frequencies where the distance between any source fragment and any target fragment is greater than the actual radius of the wire being modeled. Applications of this fragmentary model with actual experiments can be found in New Induction Applications Volume 1 [NIA1]. Note: the paper uses older NEV3 notation and language but the derivations and experimental results are still valid.

For applications where source and target fragments are in close proximity, solid wire modeling (SWM) must be used. For low frequency SWM see graduate thesis [Thesis]. For high frequency, see section 4.1.3.

4.1.2 Self Inductance

Self Inductance is the case where the source and the target are the same loop. An inductor is an example self inductance. Self inductance occurs in every section of a conductor that contains a time changing current. This includes open loop constructs such as a dipole antenna. New Electromagnetism is free of the constraint of classical electromagnetism requiring a loop to enclose a magnetic field for inductance to occur (this is a violation of locality). Instead, New Electromagnetism uses line-of-sight (optical) modeling which is easier to apply and faster numerically. Optical models allow for the computation of ground plane and dual ground plane effects (see graduate thesis [THESIS]).

The interfragmentary models developed in this chapter are not applicable to self-inductance (inductor) modeling because distances go to zero resulting in a singularity. Inductance modeling requires Solid Wire Modeling (SWM) as shown in Figure 4-2. The picture shows false color mapping indicating the relative amplitude of the inertial force in the wire. The red dots in the diagram are arrow heads indicating the direction of the inertial force in the wire. With classical theory it is not possible to determine the amplitude and direction of the force at any arbitrary point in the wire (A violation of the 17th Rule of Acquisition: The Ambiguity Tell). The picture comes from the graduate theses [THESIS] which developed the low frequency self-inductance models. High-frequency models are discussed in section 4.1.3.

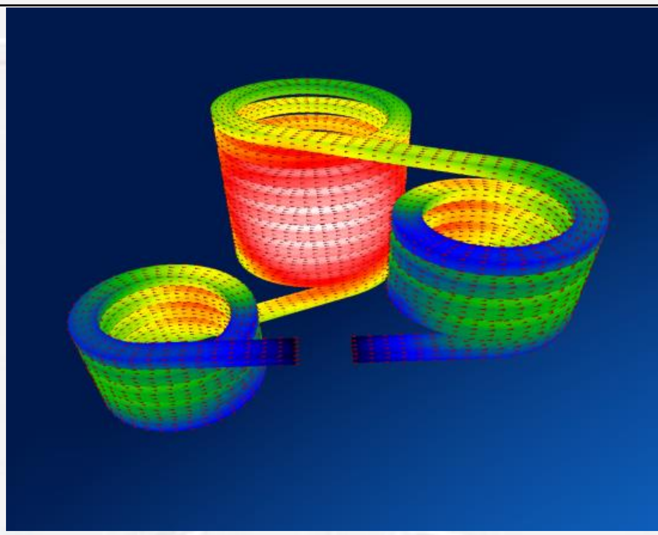


Figure 4-2: Solid Wire Self Inductance Modeling

4.1.3 High Frequency Inductance

More advanced applications involve solid wire modeling at high frequencies. These techniques are being developed into a software simulation tool.

4.2 Coriolis Charge Motion

Because the inertial field model concerns charges that are accelerating, then all charge acceleration effects must be accounted for. This includes coriolis charge motion, centripetal charge motion (Section 4.3) and venturi charge motion (section 4.4). New Electromagnetism Version 5 is the very first electromagnetic theory to model and quantify these effects.

4.2.1 Coriolis Acceleration

All objects moving in a rotating reference frame experience acceleration known as Coriolis acceleration. The phenomenon of Coriolis acceleration is adequately discussed in textbooks and will not be discussed here. This section derives Coriolis effects of current carrying conductors on rotating systems which is called Coriolis charge motion.

The standard vector model for coriolis acceleration is given by

$$\mathbf{a}_{Cor} = 2\mathbf{\Omega}\times\mathbf{V}_{\Omega}$$

The symbol a_{Cor} is the acceleration experience by an object moving with velocity V_{Ω} in a reference frame spinning with angular velocity Ω. This spinning reference frame is represented as a grey disk in Figure 4-3. The reference frame is spinning with angular velocity Ω and will be referred to as the Ω reference frame for convenience. The acceleration and angular velocity vectors are in the coordinate systems of the outer or external reference frame. The external reference frame contains the Ω reference frame. Since nothing else is defined in the example, the external reference frame of Ω is the outermost reference frame which is the Ethereal Reference frame. For the purposes of modeling and experiments in this paper, a stationary uniform ethereal medium is the default unless stated otherwise. All charge motion must be computed relative to the Ethereal Medium to determine effects.

The velocity V_{Ω} uses the subscript Ω to delineate that that velocity is relative to the Ω reference frame.

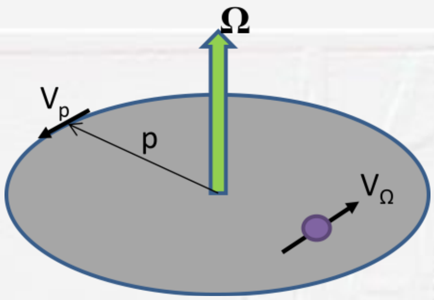


Figure 4-3: Coriolis Parameterization (legacy vectors)

In Vortrix Algebra, the rotational quantity **Ω** is expressed as a vortex matrix using the following

$[\mathbf{\Omega}] = [\mathbf{Vp} / \mathbf{p}]$ (for Vp and p perpendicular)

The vector **p** represents the distance from the axis of rotation to any point in the rotating reference frame. Vector **p** must be perpendicular to the axis of rotation. The Vector **Vp** represents the tangential velocity of the point. The vector **Vp** must be perpendicular to both the vector **p** and the axis of rotation. Finally, vectors $\mathbf{V_P}$ and **p** are in the external coordinate system.

The square brackets remind us that the result of the Vortrix expression results in a matrix (rather than a vector).

The coriolis acceleration of an object moving in the **Ω** reference frame is given by the Vortrix expression:

$$\mathbf{a}_{Cor} = 2[\mathbf{\Omega}]\mathbf{V}_{\Omega}$$

Equation 4-4: Coriolis Acceleration - Vortrix Representations

4.2.2 Coriolis Charge Motion

Coriolis acceleration of moving charges emits inertial forces that must be accounted for when computing effects from magnets, current carrying conductors and other similar constructs. The derivation of charge motion for conductors begins with Equation 4-4. The velocity term for the charge velocity in a current carrying source fragments is found by solving Equation 1-2 for V and substituting into Equation 4-4 to yield

$$\mathbf{a}_{Cor} = 2[\mathbf{\Omega}]\frac{I_S d\mathbf{L}_S}{dQ_S}$$

Since V is essentially the conduction velocity in the source wire fragment. Multiplying both sides by dQ_S make the left side differential charge acceleration

$$dQ_S\mathbf{a}_{Cor} = 2I_S[\mathbf{\Omega}]d\mathbf{L}_S$$

Now it can be substituted into the inertial force model (Equation 2-3) to yield the fragmentary force on a point charge.

$$d\mathbf{F}_T = -2Q_T I_S \frac{[\mathbf{\Omega}]d\mathbf{L}_S}{|\mathbf{r}|}$$

Equation 4-5: Coriolis Inertial Force, F-P

Next, divide both side by Q_T and dot product both sides with dL_T to convert to fragment-to-fragment vim

$$ddVim_T = -2I_S \frac{[\boldsymbol{\Omega}]d\mathbf{L}_S}{|\mathbf{r}|} \bullet d\mathbf{L}_T$$

Equation 4-6: Coriolis Inertial Vim, F-F

The application of these equations is demonstrated later.

4.3 Centripetal Charge Motion

Centripetal charge motion is the acceleration resulting from moving charges that are changing direction. This could either be charges in a spinning reference frame or charges accelerating around the bend of a wire.

The centripetal charge acceleration resulting from a spinning reference frame is a simple application of the inertial force model to be covered in future experimental supplements. The case of current accelerating around the curve of a wire is more complex and required for a complete understanding of current carrying conductors applied in later chapters.

Curved conducting loops can be divided into two categories. The first is a loop or arc of wire requiring a complex integration to accurately quantify the effect on a target. The second is a bend of a wire which can be modeled as a junction effect. A junction effect is an effect that occurs over such a short distance that it can be treated as a point source.

4.3.1 Centripetal Wire Bend Effects

Electric current traveling around the bend of a wire must accelerate. Figure 4-4 defines how the bend angle is parameterized for derivation purposes. The green arrows represent the direction of the acceleration impulse. The point of the bend is treated like a junction to simplify the application. The derivation uses the same wire properties for the conductor entering the bend and exiting the bend. A more complex derivation could have different wire properties entering and exiting the bend.

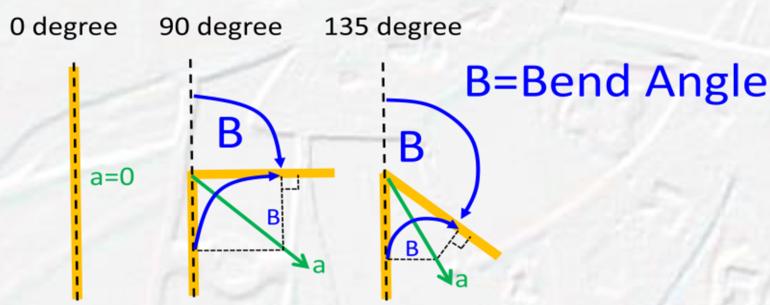


Figure 4-4: Bend Angle Definition

The derivation begins by evaluating the charge acceleration around an arc of a non-zero radius.

Figure 4-5 shows a test charge located to the left of the origin near the corner of a loop. This derivation only considers the portion of the loop located within the square of side length m. Outside of this square, charge is not accelerating and normal magnetic effects are considered.

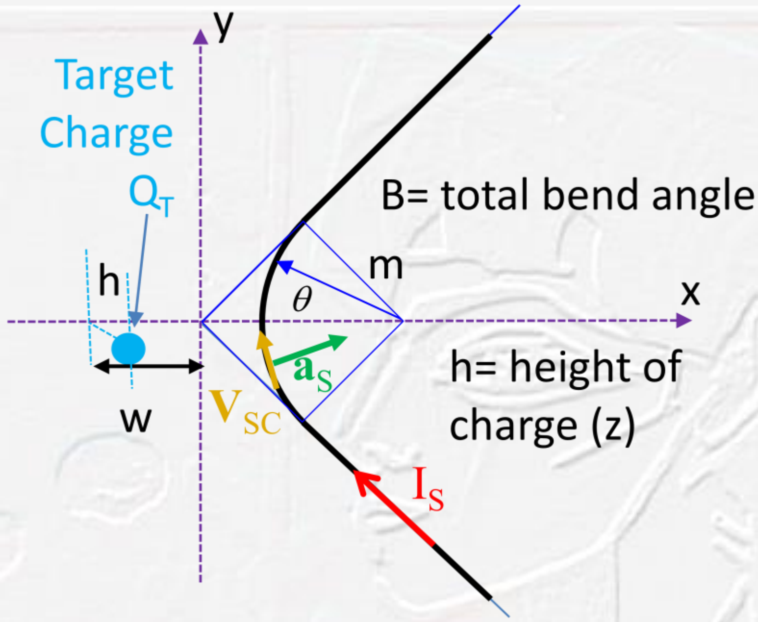


Figure 4-5: Centripetal Corner

The coordinate offset from any portion of the arc to the test charge is

$$\Delta x = w + m\sqrt{2} - m\cos\theta$$

$$\Delta y = m\sin\theta$$

$$\Delta z = h$$

$$d = \sqrt{w^2 + 3m^2 + h^2 + 2\sqrt{2}wm + (-2wm - 2\sqrt{2}m^2)\cos\theta}$$

The magnitude of centripetal acceleration along the arc is the square of the conduction velocity divided by the radius. In this case, the conduction velocity symbol V_C is further decorated with the subscript S to denote that it is the property of the source charge.

$$a_{CENT} = \frac{V_{SC}^2}{m}$$

The magnitude of the conduction velocity is obtained from Equation 1-7. Substituting

$$a_{CENT} = \frac{I_S^2}{Q_{SPM}^2 m}$$

The direction of the centripetal acceleration is

$$\hat{\mathbf{a}}_{CENT} = (\cos\theta, \sin\theta, 0)$$

The quantity of charge in each differential length of conductor is given by Equation 1-6.

Substituting all of this into the Inertial Force model yields

$$d\mathbf{F}_T = -\frac{Q_T I_S^2}{Q_{SPM}\, m} \frac{(\cos\theta \hat{\mathbf{x}}, \sin\theta \hat{\mathbf{y}}, 0\hat{\mathbf{z}}) dLs}{\sqrt{w^2 + 3m^2 + h^2 + 2\sqrt{2}wm + (-2wm - 2\sqrt{2}m^2)\cos\theta}}$$

Next, dL_S is replaced with $md\theta$

$$d\mathbf{F}_T = -\frac{Q_T I_S^2}{Q_{SPM}} \frac{(\cos\theta \hat{\mathbf{x}}, \sin\theta \hat{\mathbf{y}}, 0\hat{\mathbf{z}}) d\theta}{\sqrt{w^2 + 3m^2 + h^2 + 2\sqrt{2}wm + (-2wm - 2\sqrt{2}m^2)\cos\theta}}$$

Logically, because the target is constrained to the **x**-axis and the bend is symmetric about the x-axis, the integration of the **y** component of force is zero; the expression the reduces to

$$\mathbf{F}_T = -\frac{Q_T I_S^2}{Q_{SPM}} \int_{-B/2}^{B/2} \frac{\cos\theta d\theta}{\sqrt{w^2 + 3m^2 + h^2 + 2\sqrt{2}wm + (-2wm - 2\sqrt{2}m^2)\cos\theta}} \hat{\mathbf{x}}$$

Equation 4-7: Centripetal Inertial Force, target constrained to x-axis, Wire Bend, F-P

The above equation requires elliptical integrals to solve analytically which is left as an exercise to the reader. Accompanying this paper is an excel spread sheet (CentCornerAnalysis.xlsx) to provide numerical solutions for various values of m, w, h and B for the integrand. The Fizzix2 software computes centripetal effects for any scenario including the vim coupled to closed loop. Fizzix2 also provides a solver explicitly for the above problem which is shown in the following screen shot.

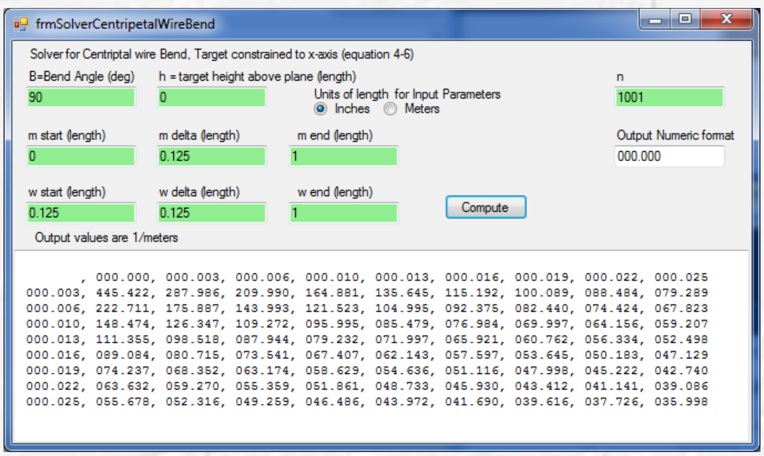


Figure 4-6: Centripetal Bend, Solver Example

The solver solves for a range of m and w. The top row is the values of m in meters, the left column is the values of w in meters and the remainder is the tabular results in reciprocal meters. The results for the solver and the spread sheet still need to be multiplied by values in front of the integrand as shown in the following.

$$\mathbf{F}_T = -\frac{Q_T I_S^2}{Q_{SPM}} (\text{spread sheet or solver results})$$

$$\mathbf{F}_T = -K_M \frac{Q_T I_S^2}{Q_{SPM}} (\text{spread sheet or solver results})$$

Centripetal Wire Bend Junction Solution

Equation 4-7 is simplified for a zero radius bend by setting m to zero which yields

$$\mathbf{F}_T = -\frac{Q_T I_S^2}{Q_{SPM}\sqrt{w^2+h^2}}\hat{\mathbf{x}}\int_{-B/2}^{B/2}\cos\theta\, d\theta$$

This is resolved easily

$$\mathbf{F}_T = -\frac{Q_T I_S^2 (2\,\mathrm{Sin}(B/2))}{Q_{SPM}\sqrt{w^2+h^2}}\hat{\mathbf{x}}$$

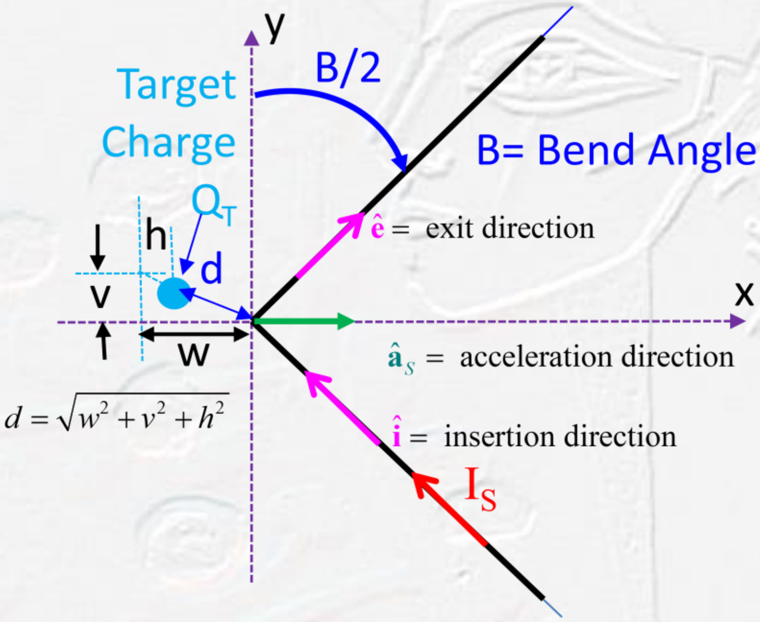


Figure 4-7: Zero-Radius Centripetal Bend

This simplification allows the entire effect to be approximated as a point effect at the origin. Since the inertial force is isotropic, the distance expression in the denominator is replaced by a generalized distance variable d.

The present acceleration direction (x) is specific to the problem setup. To generalize it for any given vector implementation, it is replaced with the following expression for the direction of acceleration base on the insertion vector and exit vectors shows in Figure 4-7. (This expression is derived using Vortrix Algebra).

$$\hat{\mathbf{a}}_S = \frac{\hat{\mathbf{e}}-\hat{\mathbf{i}}}{\left|\hat{\mathbf{e}}-\hat{\mathbf{i}}\right|} = \frac{\hat{\mathbf{e}}-\hat{\mathbf{i}}}{\sqrt{\left(\hat{\mathbf{e}}-\hat{\mathbf{i}}\right)^2}} = \frac{\hat{\mathbf{e}}-\hat{\mathbf{i}}}{\sqrt{\hat{\mathbf{e}}\hat{\mathbf{e}}+\hat{\mathbf{i}}\hat{\mathbf{i}}-\hat{\mathbf{i}}\hat{\mathbf{e}}-\hat{\mathbf{e}}\hat{\mathbf{i}}}} = \frac{\hat{\mathbf{e}}-\hat{\mathbf{i}}}{\sqrt{2-2\hat{\mathbf{e}}\bullet\hat{\mathbf{i}}}}$$

Furthermore, the bend angle coefficient (2Sin(B/2)) is replaced by a dot product expression as shown in the following

$$2\,\mathrm{Sin}(B/2) = (\hat{\mathbf{e}}-\hat{\mathbf{i}})\bullet\hat{\mathbf{a}}_S$$

This results in the following

$$\mathbf{F}_T = -\frac{Q_T I_S^2\left((\hat{\mathbf{e}}-\hat{\mathbf{i}})\bullet\hat{\mathbf{a}}_S\right)}{Q_{SPM}\, d}\hat{\mathbf{a}}_S$$

Substituting $\mathbf{a}_S$,

$$\mathbf{F}_T = -\frac{Q_T I_S^2 \left((\hat{\mathbf{e}}-\hat{\mathbf{i}}) \bullet \frac{\hat{\mathbf{e}}-\hat{\mathbf{i}}}{\sqrt{2-2\hat{\mathbf{e}}\bullet\hat{\mathbf{i}}}} \right)}{Q_{SPM}\, d} \frac{\hat{\mathbf{e}}-\hat{\mathbf{i}}}{\sqrt{2-2\hat{\mathbf{e}}\bullet\hat{\mathbf{i}}}}_S$$

Reducing

$$\mathbf{F}_T = -\frac{Q_T I_S^2 \left(\sqrt{2-2\hat{\mathbf{e}}\bullet\hat{\mathbf{i}}} \right)}{Q_{SPM}\, d} \frac{\hat{\mathbf{e}}-\hat{\mathbf{i}}}{\sqrt{2-2\hat{\mathbf{e}}\bullet\hat{\mathbf{i}}}}_S$$

$$\mathbf{F}_T = -\frac{Q_T I_S^2}{Q_{SPM}\, d} \left(\hat{\mathbf{e}}-\hat{\mathbf{i}} \right)$$

Replacing d with the standard vector r which is defined as the position of target – position of the source (wire bend) results in the following.

$$\mathbf{F}_T = \frac{Q_T I_S^2}{Q_{SPM}} \frac{\left(\hat{\mathbf{i}}-\hat{\mathbf{e}} \right)}{|\mathbf{r}|}$$

Equation 4-8: Centripetal Inertial Force J-P, Zero-Radius Wire Bend Junction to Point

Applying the Point-Force to Fragmentary–Vim conversion (Section 1.12) to obtain the vim version

$$dVim_T = \frac{I_S^2}{Q_{SPM}} \frac{\left(\hat{\mathbf{i}}-\hat{\mathbf{e}} \right)}{|\mathbf{r}|} \bullet d\mathbf{L}_T$$

4-9: Centripetal Inertial Vim J-F, Zero-Radius Wire Bend Junction to Fragment

This effect is extremely small for good conductors because of the Q_{SPM} in the denominator and the extremely small footprint of a junction (bend in wire). Furthermore, the reconciliation of all effects pertaining to a conductive loop further diminishes this effect. Future experiments/applications are being developed to magnify this effect.

4.3.2 Centripetal Loop Effects

The next consideration for centripetal charge motion effects is the charge acceleration in a circular loop

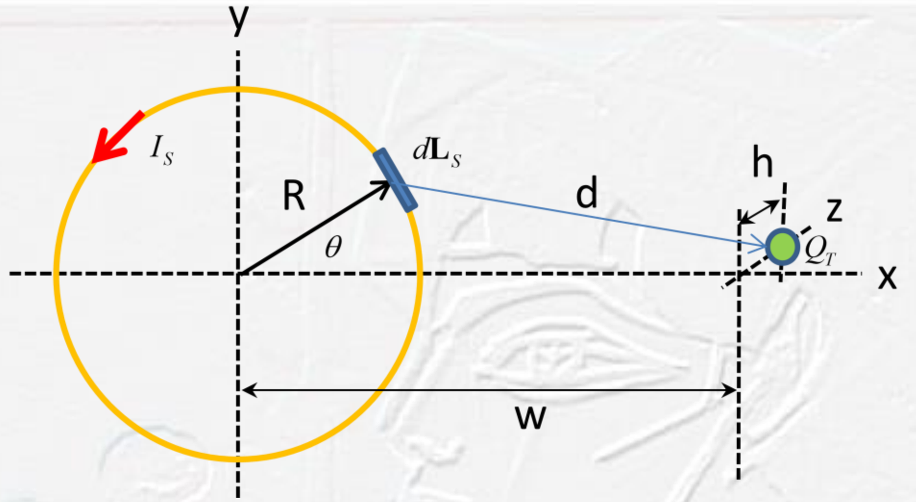


Figure 4-8: Centripetal Loop parameterization

Figure 4-8 is the experiment. Writing down the vector quantities

$$\mathbf{P}_T = w, 0, h$$
$$\mathbf{P}_S = R\cos(\theta), R\sin(\theta), 0$$
$$|d\mathbf{L}_S| = Rd\theta$$
$$d\hat{\mathbf{L}}_S = -\sin(\theta), \cos(\theta), 0$$
$$\mathbf{a}_S = -\frac{V_{SC}^2}{R}(\cos(\theta)\hat{\mathbf{x}}, \sin(\theta)\hat{\mathbf{y}}, 0)$$

$$\mathbf{d} = \mathbf{P}_T - \mathbf{P}_S = w - R\cos(\theta), -R\sin(\theta), h$$
$$|\mathbf{d}| = \sqrt{w^2 + R^2 + h^2 - 2wR\cos(\theta)}$$

$$dQ_S = Q_{PMS}\,|d\mathbf{L}_S|$$

The above are substituted into the Equation 2-3.

$$d\mathbf{F}_T = \frac{Q_T Q_{SPM}\,|d\mathbf{L}_S|\frac{V_{SC}^2}{R}(\cos(\theta)\hat{\mathbf{x}}, \sin(\theta)\hat{\mathbf{y}})}{\sqrt{w^2 + R^2 + h^2 - 2wR\cos(\theta)}}$$

Further substitutions

$$d\mathbf{F}_T = \frac{I_S^2 Q_T(\cos(\theta)\hat{\mathbf{x}}, \sin(\theta)\hat{\mathbf{y}})d\theta}{Q_{SPM}\sqrt{w^2 + R^2 + h^2 - 2wR\cos(\theta)}}$$

For a closed loop, the sine component is discarded because it is symmetrical about the X-axis which means the effect from the top of the loop cancels with that of the bottom of the loop.

$$\mathbf{F}_T = \frac{I_S^2 Q_T}{Q_{SPM}} \int_0^{2\pi} \frac{\cos(\theta)d\theta}{\sqrt{w^2 + R^2 + h^2 - 2wR\cos(\theta)}} \hat{\mathbf{x}}$$

Equation 4-10: Centripetal Inertial Force L-P, target constrained to x-axis.

Like the previous section, the analytical solution requires elliptical integrals to solve. The preferred solution is to use the Fizzix2 software which uses the generalize solution (section 4.3.3) to compute centripetal effects for any shaped loop of any type or shape of target. The following Solver is available in Fizzix2 and used to validate the Fizzix2 core.

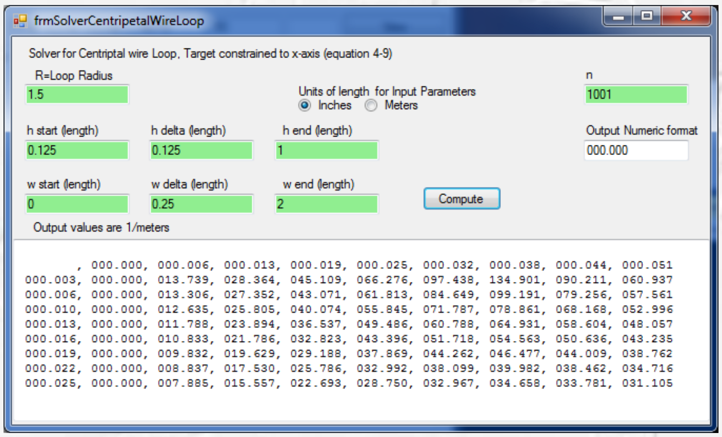


Figure 4-9: Centripetal Loop, Solver Example

Again, the solver only solves the integral over various ranges of h and w. The results in the body of the table must be multiplied by coefficients and then converted as necessary (same procedure as previous solver). The columns in the table are increasing values of w; the rows are increasing values of h.

4.3.3 Generalized Fragmentary Arc Centripetal Charge Motion

This section introduces the general solution for fragmentary arcs suitable for numerical integration of arbitrary wire constructs containing various arcs and curves.

The following diagram shows the meandering path of an arbitrary wire construct. The fragment being considered (blue) is in a curved section of the loop with a specified radius R.

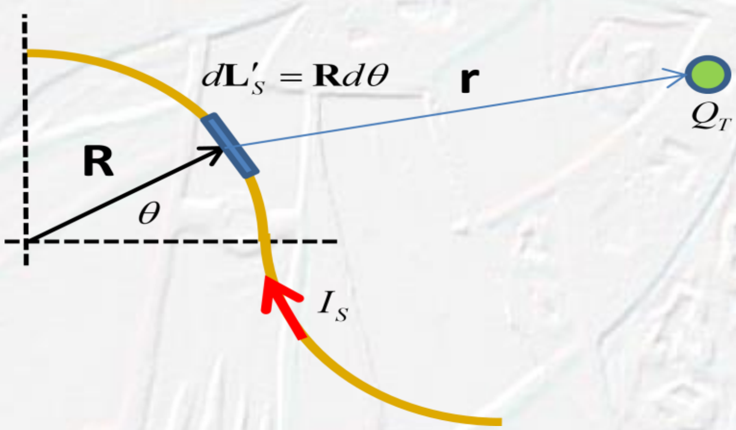


Figure 4-10: Fragment of Arc

The centripetal acceleration of the charges around the arc is given by

$$\mathbf{a}_S = -\frac{V_{SC}^2 \hat{\mathbf{R}}}{|\mathbf{R}|}$$

The source charge in the fragment is

$$dQ_S = Q_{SPM} |d\mathbf{L}_S|$$

Substituting into Inertial Force model

$$\mathbf{F}_T = \frac{Q_T Q_{SPM} |d\mathbf{L}_S|}{|\mathbf{r}|} \frac{V_{SC}^2 \hat{\mathbf{R}}}{|\mathbf{R}|}$$

Substituting

$$V_{SC} = \frac{I_S d\mathbf{L}_S}{Q_{SPM} |d\mathbf{L}_S|}$$

Yields

$$d\mathbf{F}_T = \frac{Q_T I_S^2 |d\mathbf{L}_S|}{Q_{SPM} |\mathbf{R}|} \frac{\hat{\mathbf{R}}}{|\mathbf{r}|} = \frac{Q_T I_S^2 d\theta}{Q_{SPM}} \frac{\hat{\mathbf{R}}}{|\mathbf{r}|} \qquad \text{note: } d\theta = \frac{|d\mathbf{L}_S|}{|\mathbf{R}|}$$

Equation 4-11: Centripetal Inertial Force F-P, Fragmentary Arc to Point

Applying the Point to Fragmentary–Vim conversion (Section1.13) to obtain the vim version

$$ddVim_T = \frac{I_S^2 |d\mathbf{L}_S|}{Q_{SPM} |\mathbf{R}|} \frac{\hat{\mathbf{R}}}{|\mathbf{r}|} \bullet d\mathbf{L}_T = \frac{I_S^2 d\theta}{Q_{SPM}} \frac{\hat{\mathbf{R}}}{|\mathbf{r}|} \bullet d\mathbf{L}_T$$

Equation 4-12: Centripetal Inertial Force F-F, Fragmentary Arc to Fragment

Because of the Q_{SPM} in the denominator this is a very small effect that can be ignored in most cases. Later experimental supplements demonstrate a means to magnify this effect for measurement.

4.4 Venturi Charge Motion

Venturi charge motion is charge acceleration resulting from current passing between conductors of different resistances. Resistance depends upon the conductivity of the material as well as the cross sectional area. Figure 4-11 shows an example of a current in conductor of cross sectional area A_1 transitioning (section J) to conductor of cross sectional area A_2.

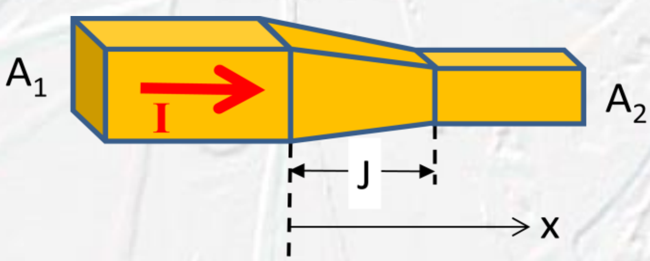


Figure 4-11: Venturi Charge Motion

Charges in section J must undergo acceleration identical to Venturi acceleration of fluid dynamics. Accelerating charges emit an inertial force that must be accounted for.

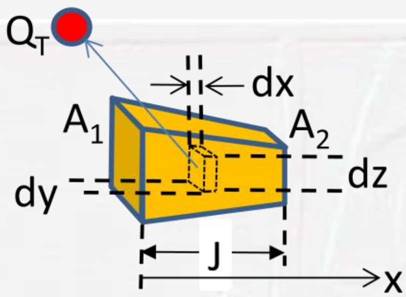


Figure 4-12: Parameterization of section J (Chunks)

The objective is to derive a charge acceleration (Qa) expression to substitute in to the inertial force model. Normally, the derivation would integrate the effect of each differential volume dxdydz (See Figure 4-12) which would account for the varying distances between the chunks and the target as well as the change in charge density. To simplify the derivation (see Figure 4-13), assume the target is sufficiently far away that the variations of the vector **r** over section J are negligible. In this case, the derivation integrates the total charge acceleration over the volume into a lump charge acceleration value (Qa). This is called junction modeling because the entire effect is approximated as a lump effect occurring at the point of the junction between two dissimilar conductors. Because of this simplification, the integration can be reduced from a volume integral of chunks to a line integral of slices.

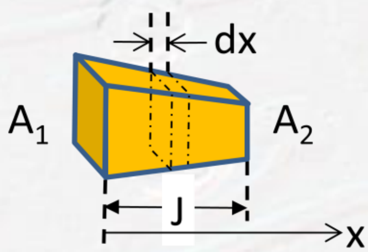


Figure 4-13: Simplified Parameterization (Slices)

The derivation begins by considering the cross sectional area as a function of x

$$A(x) = \frac{A_2 - A_1}{J} x + A_1$$

The mobile charges in slice dx as a function of x is

$$dQ(x) = Q_{M3} A(x) dx$$

Q_{M3} is the mobile charge per unit volume (see Section 1.14).

The charge velocity as a function of x is

$$v(x) = \frac{Idx}{Q_{M3} A(x) dx} = \frac{I}{Q_{M3} A(x)}$$

The acceleration as a function of x is found using the chain rule

$$a(x)=\frac{d(v(x))}{dx}\frac{dx}{dt}=\frac{d(v(x))}{dx}v(x)$$

Taking the derivative of v(x)

$$\frac{d(v(x))}{dx}=\frac{I}{Q_{M3}}\frac{d}{dx}\left(\frac{1}{A(x)}\right)=\frac{I}{Q_{M3}}\frac{d}{dx}\left(\frac{1}{\frac{A_2-A_1}{J}x+A_1}\right)$$

Simplify the constants in the parenthesis into constants b and c

$$\frac{d(v(x))}{dx}=\frac{I}{Q_{M3}}\frac{d}{dx}\left(\frac{1}{bx+c}\right)=\frac{I}{bQ_{M3}}\frac{d}{dx}\left(\frac{1}{x+c/b}\right)$$

Taking the derivative

$$\frac{d(v(x))}{dx}=-\frac{I}{bQ_{M3}\left(x+c/b\right)^2}$$

Multiplying by v(x) to complete the acceleration term (don't reduce yet)

$$a(x)=\frac{d(v(x))}{dx}v(x)=-\frac{I}{bQ_{M3}\left(x+c/b\right)^2}\frac{I}{bQ_{M3}\left(x+c/b\right)}$$

Then multiply by dQ(x)

$$a(x)dQ(x)=-\frac{I}{bQ_{M3}\left(x+c/b\right)^2}\frac{I}{Q_{M3}A(x)}Q_{M3}A(x)dx$$

Now reduce

$$a(x)dQ(x)=-\frac{I^2dx}{bQ_{M3}\left(x+c/b\right)^2}$$

Next, integrate over J to obtain the lump Qa value

$$Qa=\int_0^L a(x)dQ(x)=-\int_0^L\frac{I^2dx}{bQ_{M3}\left(x+c/b\right)^2}=-\left[\frac{I^2}{Q_{M3}\left(bJ+c\right)}-\frac{I^2}{Q_{M3}\left(c\right)}\right]$$

$$Qa=\frac{I^2}{Q_{M3}}\left(\frac{bJ}{bJc+c^2}\right)$$

Restore b and c and reduce further

$$Qa = \frac{I^2}{Q_{M3}}\left(\frac{1}{A_1} - \frac{1}{A_2}\right)$$

Substitute into the inertial force model and reduce the minus sign

$$\mathbf{F}_T = Q_T \frac{I_S{}^2}{Q_{M3}}\left(\frac{1}{A_2} - \frac{1}{A_1}\right)\frac{\hat{\mathbf{J}}_S}{|\mathbf{r}|} \quad \{\text{for } \mathbf{r} >> \text{J (length of junction)}\}$$

Equation 4-13: Venturi Inertial Force ATJ-P, Area Transition Junction

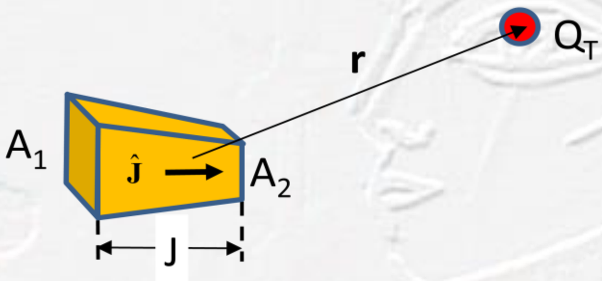


Figure 4-14: Venturi Junction

Applying the Point to Fragmentary–Vim conversion (Section 1.13) to obtain the vim in a target fragment due to a junction (J-F)

$$dVim_T = \frac{I_S{}^2}{Q_{M3}}\left(\frac{1}{A_2} - \frac{1}{A_1}\right)\frac{\hat{\mathbf{J}}_S \bullet d\mathbf{L}_T}{|\mathbf{r}|} \quad \{\text{for } \mathbf{r} >> \text{J (length of junction)}\}$$

Equation 4-14: Venturi Inertial Vim ATJ-F, Area Transition Junction

A more general expression allows for venturi effects from a change in material and/or cross section. Equation 4-13 can be converted to account for dissimilar junction by propagating the QM3 into the parenthesis. Now the Q_{SPM1} and Q_{SPM2} can be different because of material, cross section or both.

$$d\mathbf{F}_T = Q_T I_S{}^2\left(\frac{1}{Q_{SPM2}} - \frac{1}{Q_{SPM1}}\right)\frac{\hat{\mathbf{J}}_S}{|\mathbf{r}|} \quad \{\text{for } \mathbf{r} >> \text{J (length of junction)}\}$$

Equation 4-15: Venturi Inertial Force J-P, General Junction

And the vim version

$$dVim_T = I_S{}^2\left(\frac{1}{Q_{SPM2}} - \frac{1}{Q_{SPM1}}\right)\frac{\hat{\mathbf{J}}_S \bullet d\mathbf{L}_T}{|\mathbf{r}|} \quad \{\text{for } \mathbf{r} >> \text{J (length of junction)}\}$$

Equation 4-16: Venturi Inertial Vim J-F, General Junction

For application involving long tapered sections, or a junction that bends around a corner, a more complex model is required. This section provides a solid foundation for any venturi type effect that needs to be modeled.

5 Advanced Models

This section combines the fragmentary models from Sections 3 and 4 to develop advanced models for wires and magnets.

5.1 Conductors

Conductive loops can either be the source of an effect, the target of an effect or both. When acting as the target, it is a simple matter to integrate the target fragments over a loop (or portion thereof) to determine the force or the vim.

The modeling of conductive loops from the source perspective falls into two categories; the complete solution and the good solution.

5.1.1 The Complete Solution

The complete modeling of a conductor as a source requires consideration of all effects discussed in sections 3 and 4. Most of the effects are negligible for good conductors (see next section); however for extreme conditions (High Current, High Resistance, etc), some or more of these effects may dominate and must be considered.

5.1.2 The Good Solution

Good conductors have charge densities (Q_{M3}) on the order of 10^{10} which results in values of 10^4 for the Q_{PM} of fine wire gauges. The effects containing either of these values in the denominator are negligible under ideal conditions and can therefore be ignored. The remaining effects are

1) Section 3: Fragmentary Wire Magnetism (Source or Target Coil in motion)
2) Section 4.1: Inductance (Time Varying Current) (Time Varying Source Currents)
3) Section 4.2: Coriolis Charge Motion (Rotating Source Coils)

5.2 Magnets

This section develops fragmentary models for magnets based on the charge motion models of Sections 3 and 4

5.2.1 Edge Current Model of Magnets

Magnets can be modeled as loops of current carrying wire. This modeling technique is thoroughly explored in Section 8 of the paper New Magnetism [NM] (from New Electromagnetism Version 3 (NEV3)) and included here by reference. For NEV5, this model is expended with the addition of Coriolis Charge motion effects.

Photos from the paper (Figure 5-1) demonstrate how to identify the location of the edge currents using magnetic viewing film. For Neodymium Magnets the edge currents are typically 3000 to 3500 amps for each 1/8th inch of thickness. An apparatus for quantifying edge currents does exist; however, the parts have become obsolete. An improved apparatus is presently being developed.

Figure 5-2 shows a screen capture of the Fizzix2 software demonstrating the location of the edge currents with copper colored wires.

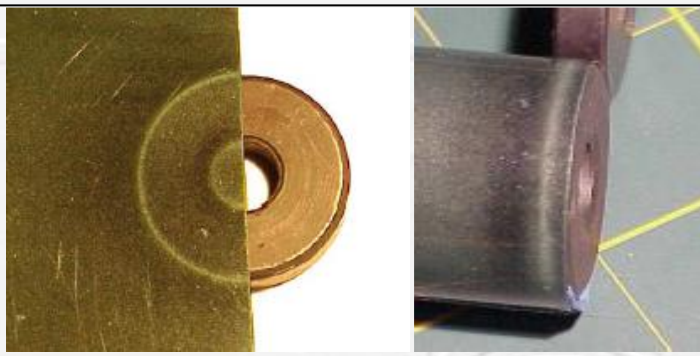


Figure 5-1: Images showing Magnet Edge Currents using magnetic viewing film

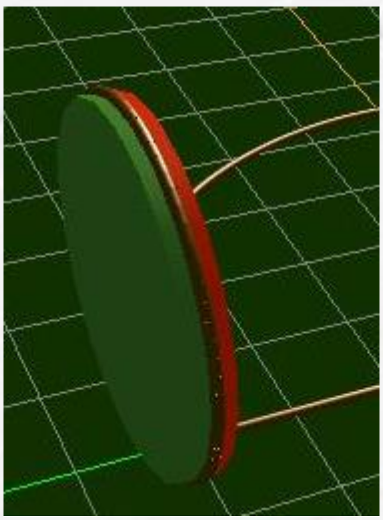


Figure 5-2: Fizzix2 Software with Edge Currents shown as Wires

5.2.2 Magnet Effects

Because the magnetic field from a magnet is the composition of atomic sized current rings, there are no venturi effects. Furthermore, because each current ring produces equal and opposite centripetal effects, there are no measureable centripetal contributions. The only two effects of any relevance are

1) Section 3: Fragmentary Wire Magnetism
2) Section 4.2: Coriolis Charge Motion

These effects are demonstrated in the experimental section of this paper. In section 7.2 the rotating magnet experiments demonstrate excellent agreement with experimental results by considering the interfragmentary magnetic and coriolis effects. In section 7.2.1, the experiments are simulated again without consideration of the Coriolis effects with poor results.

6 Other Applications

6.1 Hall Effect

The Hall Effect is the deflection of current in a conductor exposed to a magnetic field. A Hall Effect experiment is shown in Figure 6-1. The Hall Effect Target is the conductive (orange) rectangle at the center of the diagram. The target is fed from left to right by current I_T sourced by the red current source near the bottom of diagram. The target is exposed to a magnetic field generated by the current I_S in the large orange loop (source loop). As the current passes across the length (L) of the target, it is deflected across the width (W) by the magnetic field. This causes mobile carriers to concentrate on one side of the target resulting in a voltage measurable by the Volt meter (V).

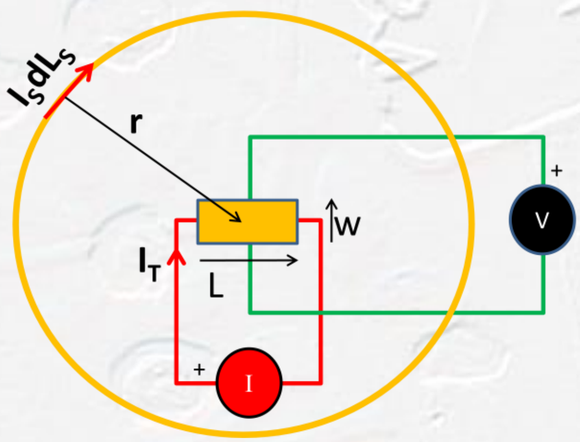


Figure 6-1: Hall Effect Experiment

According to the magnetic force model (Equation 3-1: Magnetic Force F-P), the effect is maximized by the speed (V_T) at which the mobile carriers transit the target (Figure 6-2).

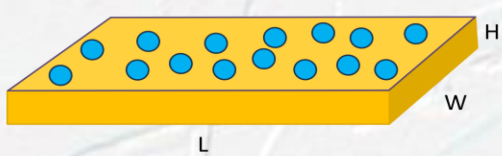


Figure 6-2: Hall Effect Target

The mobile carriers in the target as a function of length can be found by a modified form of Equation 1-5

$$Q_{TPM} = Q_{TM3} HW$$

The velocity of conduction charges across the target is found substituting the above into Equation 1-7

$$\mathbf{V}_{TC} = \frac{I_T}{\mathrm{Q}_{\mathrm{TPM}}} d\hat{\mathbf{L}}_T = \frac{I_T}{\mathrm{Q}_{\mathrm{TM3}} HW} d\hat{\mathbf{L}}_T$$

Substitute the above into Equation 3-1 yields

$$d\mathbf{F}_T = Q_T I_S \frac{[d\mathbf{L}_S / \hat{\mathbf{r}}]}{\mathbf{r}^2} \frac{I_T d\hat{\mathbf{L}}_T}{Q_{TM3} HW}$$

Rearranging

$$d\mathbf{F}_T = \frac{Q_T I_S I_T}{Q_{TM3} HW} \frac{[d\mathbf{L}_S / \hat{\mathbf{r}}] d\hat{\mathbf{L}}_T}{\mathbf{r}^2}$$

To turn this equation into a vim equation, divide both sides by Q_T and perform dot product along the direction that vim is desired to be measured. In this case, the direction is along the width, thus

$$ddVim_T = \frac{I_S I_T}{Q_{TM3} HW} \frac{[d\mathbf{L}_S / \hat{\mathbf{r}}] d\hat{\mathbf{L}}_T}{\mathbf{r}^2} \bullet d\mathbf{W}$$

The following assumes that the target is smaller than the loop such that the magnetic effect over the target is approximately uniform. This allows us to simplify as follows:

Note: the following paragraph attempts to explain the rotational nature of the Vortrix Matrix as applied to this experiment. In case the example is not clear, there is another description of the phenomenon in section 1.3.1 Properties of the Vortrix Product.

Because the target is at the center of the source loop, the direction from each source fragment to the target is 90 degrees right of the direction of the fragment. If the direction of $\mathbf{r}$ to direction of $d\mathbf{L}_S$ is 90 degrees, then the matrix $[d\mathbf{L}_S / \mathbf{r}$] rotates charges moving in the target by 90 degrees which reorients it in the direction of W. Furthermore, since each fragment has a similar effect, the integration around the source can be replaced with the circumference of the source (2πr).

$$dVim_T = \frac{I_S I_T 2\pi r}{Q_{TM3} HW \mathbf{r}^2} \hat{\mathbf{W}} \bullet d\mathbf{W}$$

Again, the presumption of uniform magnetic affects over the target allows the integration over width to be replaced with the width

$$Vim_T = \frac{I_S I_T 2\pi r}{Q_{TM3} HW \mathbf{r}^2} W$$

Final reduction

$$Vim_T \cong \frac{I_S I_T 2\pi}{Q_{TM3} Hr}$$

Because there is no significant reactance between the target and the volt meter, the Vim registers directly as a voltage on the volt meter thus:

$$V_{Hall} \cong \frac{I_S I_T 2\pi}{Q_{TM3} Hr} \qquad V_{Hall} \cong K_M \frac{I_S I_T 2\pi}{Q_{TM3} Hr}$$

Equation 6-1: Hall Effect Voltage (Natural and Legacy units)

The above equation is consistent with the Hall voltage derived from classical theory which is

$$V_{Hall} \cong \frac{R_H B I_T}{H} \text{ where } R_H = \frac{1}{Q_{M3}} \quad and \quad B = K_M \frac{2\pi I_S}{r}$$

6.2 Solid Wire Modeling (SWM)

For applications such requiring higher precision, higher frequency or self inductance, a Solid Wire Modeling (SWM) approach is introduced.

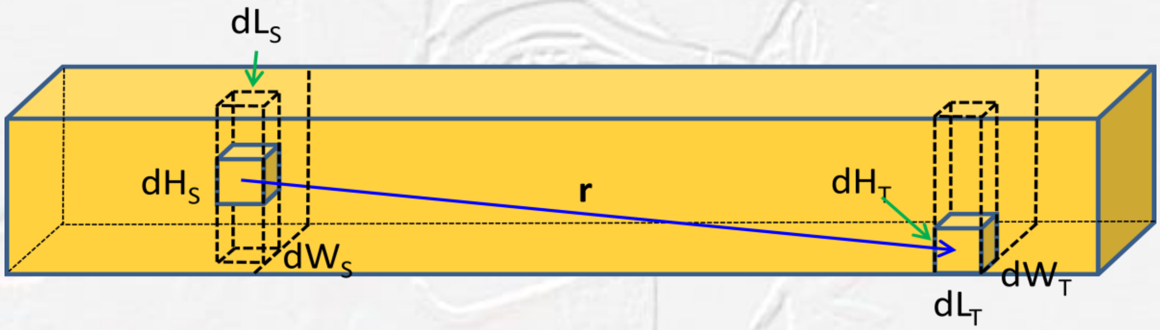


Figure 6-3: Solid Wire Example

Figure 6-3 shows how a solid conductor can be parameterized into differential volumes (dLdHdW) called chunks for brevity. For self-inductance applications, the source and target chunks reside in the same conductor as shown in Figure 6-3. Most other applications have the source and target chunks in different conductors. Wires with circular cross-sections would benefit from a cylindrical chunking method.

A future software application called Fizzix3 is based on SWM for high precision, high frequency modeling which will include self inductance.

The graduate thesis [THESIS] goes into full detail of the application of SWM to self-inductance. The thesis does use older notation; however, the application is sound and will not be repeated here. The thesis software reduced computation time by a factor of 10 by judiciously varying the chunk sizes as shown in the following picture.

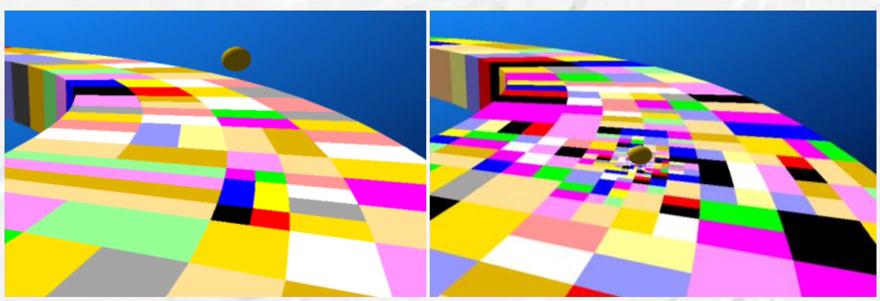


Figure 6-4: Solid Wire Chunking

The picture on the left shows a test charge suspended over a solid conducting printed circuit board trace under high magnification. The software highlights the chunks by assigning each a random color. The sizes of the chunks increase by the inverse square distance from the test charge. The right picture shows the test charge moved closer and consequently finer chunk sizes are selected by the simulation algorithm. This software has been release as an executable; however, the source code remains a trade secret.

7 Experiments

The experimental emphasis of this paper is on the Magnetic Force Model and the new charge motion effects (Centripetal, Venturi, and Coriolis). These are the major improvements over previous versions of New Electromagnetism.

The other force models have significant experimental track records. The Electric Force Model (Coulomb) is essentially unchanged from classical theory except for consideration of Transvariant effects and the Inertial Force Model (New Induction) is exhaustively covered in the graduate thesis [THESIS] and New Induction Applications volume 1 [NIA1]

The Magnetic Force Model is used in section 6.1 to derive an expression for the Hall Effect that is consistent with the classically publish equations. The Interfragmentary forms of the Magnetic Force Model are numerically applied in sections 7.1 and 7.2 to simulate the experimental results of the Paradox experiments.

The Coriolis Charge effects are corroborated in section 7.2. The Centripetal and Venturi effects are subjects of future experimental supplements.

7.1 Paradox 1: The Homopolar Paradox

The Faraday Homopolar Generator (Figure 7-1) provides for one of the most interesting Paradoxes encountered with this research. All versions of New Electromagnetism and Classical theory predict the exact same value measured by the volt meter in the closing path; however, all theories disagree about the contribution of vim (emf) from each component. Because of this strange disagreement, the experiment was originally named the Paradox Experiment. The experiment was later renamed the Paradox 1 (PDX1) at the advent of newer rotating magnet variations developed to explore rotating magnet phenomenon in more detail. The newer Paradox Experiments (2 through 4) are discussed in section 7.2.

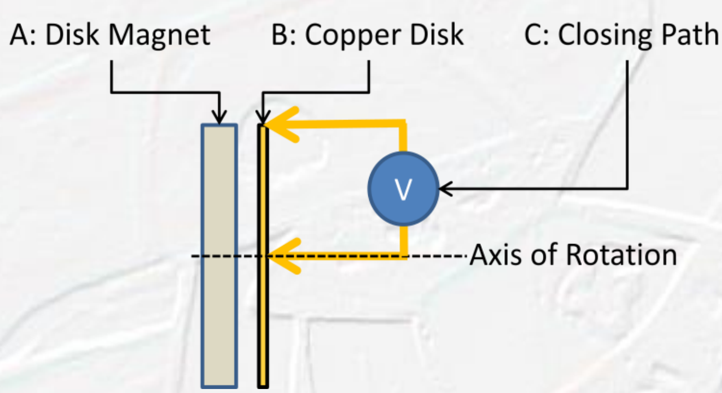


Figure 7-1: Homopolar Experiment (PDX1)

Figure 7-1 is the diagram for the homopolar generator used in this experiment. Component A is a disk magnet (shown from the side) which is situated next to a conducting disk (B). A closing path (C) contacts the conducting disk at its center and edge with brush assemblies. The closing path has an integrated volt meter (V). The experimental parameters/dimensions are shown at the end of this section.

Each component (A, B, C) is attached to a motive means allowing each to be rotated independently about the axis of rotation that passes through the centers of both disks and one arm of the closing path.

HOMOPOLAR RESULTS

					Classical --E			NEV3 / Classical--N			NEV5		
	What Rotates										Thres 1.50E-06	0.04%	0.03%
	A	B	C	Code									
mode	Magnet	Disk	Closing Path		Total	Disk	Closing	Total	Disk	Closing	Total	Disk	Closing Path
0	N	N	N	_	0	0	0	0	0	0	0.00000	0.00000	0.00000
1	Y	N	N	A	0	-0.00394	0.00394	0	0	0	0.00000	-0.00107	0.00107
2	N	Y	N	B	0.00394	0.00394	0	0.00394	0.00394	0	0.00394	0.00394	0.00000
3	Y	Y	N	AB	0.00394	0	0.00394	0.00394	0.00394	0	0.00394	0.00287	0.00107
4	N	N	Y	C	-0.00394	0	-0.00394	-0.00394	0	-0.00394	-0.00394	0.00000	-0.00394
5	Y	N	Y	AC	-0.00394	-0.00394	0	-0.00394	0	-0.00394	-0.00394	-0.00107	-0.00287
6	N	Y	Y	BC	0	0.00394	-0.00394	0	0.00394	-0.00394	0.00000	0.00394	-0.00394
7	Y	Y	Y	ABC	0	0	0	0	0.00394	-0.00394	0.00000	0.00287	-0.00287

Table 7-1: Paradox 1 Data

There are 8 modes of operation. The modes are numbered based on the combination of components that rotate. When a component rotates, it rotates at 4 turns per second. The columns A, B and C in Table 7-1 denote (with a Y for rotation) which component rotates for each mode of operation. In mode 0 (binary 000), none of the components rotate. In mode 7 (binary 111), all components rotate together.

Table 7-1 shows three blocks of simulation results representing 4 different theoretical models which are described as follows.

Classical--E

The block titled “Classical--E" uses the accepted classical magnetic model which is static about a magnet and rotates/moves with the magnet. Albert Einstein formerly declared that the magnetic field must move with the magnet; hence, the appended E stands for Einstein. This variation requires extra variables (Such as Velocity of B field, $\mathbf{V}_B$), equations and considerations that are not found in classical texts. These items are added by fiat. These considerations cause violations of the Rules of Acquisition which are discussed in Chapter 8.

NEV3/Classical--N

The block titled NEV3/Classical--N are the results from New Electromagnetism Version 3 and Classical theory where magnetic fields are modeled as static and non-moving/rotating; hence, the appended N. Both of these variants compute effects from source to target as a line of site effect which is essentially an optical solution. This is the desired approach since optical solutions (essentially emissions) do not violate the Rules of Acquisition (ROA). The Classical–N model is a two term model and was the magnetic field model used in New Electromagnetism V1 (NEV1) along with New Induction and Coulomb. NEV3 has a magnetic model with three terms which better reconciles with a model of matter and experiments.

NEV5

The block titled NEV5 contains the results for New Electromagnetism Version 5. Version 5 is also an optical solution (an emission). NEV5 does account for the rotation and motion of the system; however, such considerations account only for the motional behaviors at the locality of the emission and/or the locality of the coupling (where the emitted energy strikes the target). Therefore, NEV5 is compliant with the Rules of Acquisition.

Conclusion

Table 7-1 shows that all theories agree on the total voltage present at the voltmeter. The total is the summation of the contributions from the disk and the closing path (the components). Paradoxically, there is disagreement with regard to the contributions that make up the total. Measuring the contributions separately is the key to disambiguation; however, this is exceptionally difficult because it requires an open-loop DC measurement. While exploration of a means to make such a measurement is underway, alternative means to disqualify candidates is as follows.

NEV3 and Classical--N are both disqualified because they produce wrong answers for the Paradox 2, 3 and 4 series of experiments discussed in section 7.2.

Classical--E is disqualified because it violates the Rules of Acquisition (Chapter 8) and it fails to explain the force of inertia, the force of gravity and it fails to model self inductance of dipole antennas because there is no enclosed flux.

Experimental Parameters

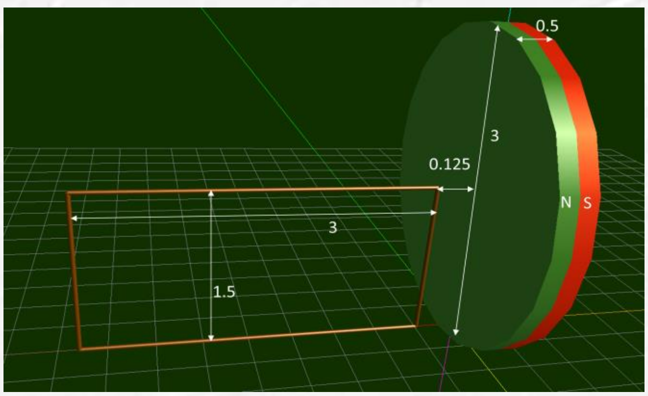
The following are the parameters used in the Fizzix2 Simulations used for all theoretical models.

Magnet Diameter = 3 inches
Magnet Thickness = 0.5 inches
Magnet Edge Current = 13700 Amps

Disk Diameter = 3 inches
Disk Gap = 0.125 inches

Closing Path Length (x) = 3 inches

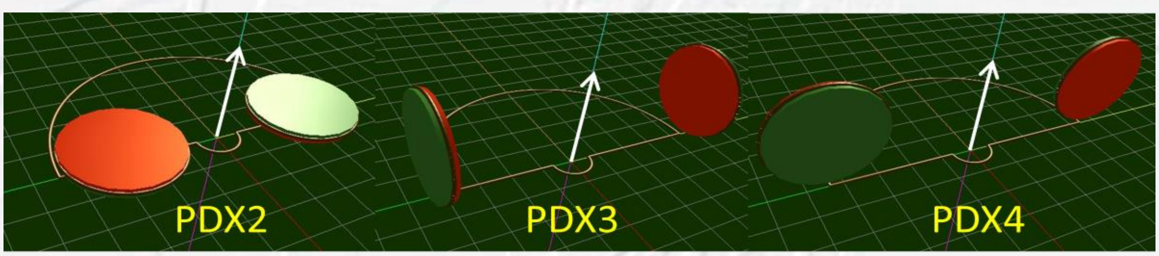
Rotation Speed = 4 Turns per Second



7-2: Fizzix2 Screen Capture of PDX1

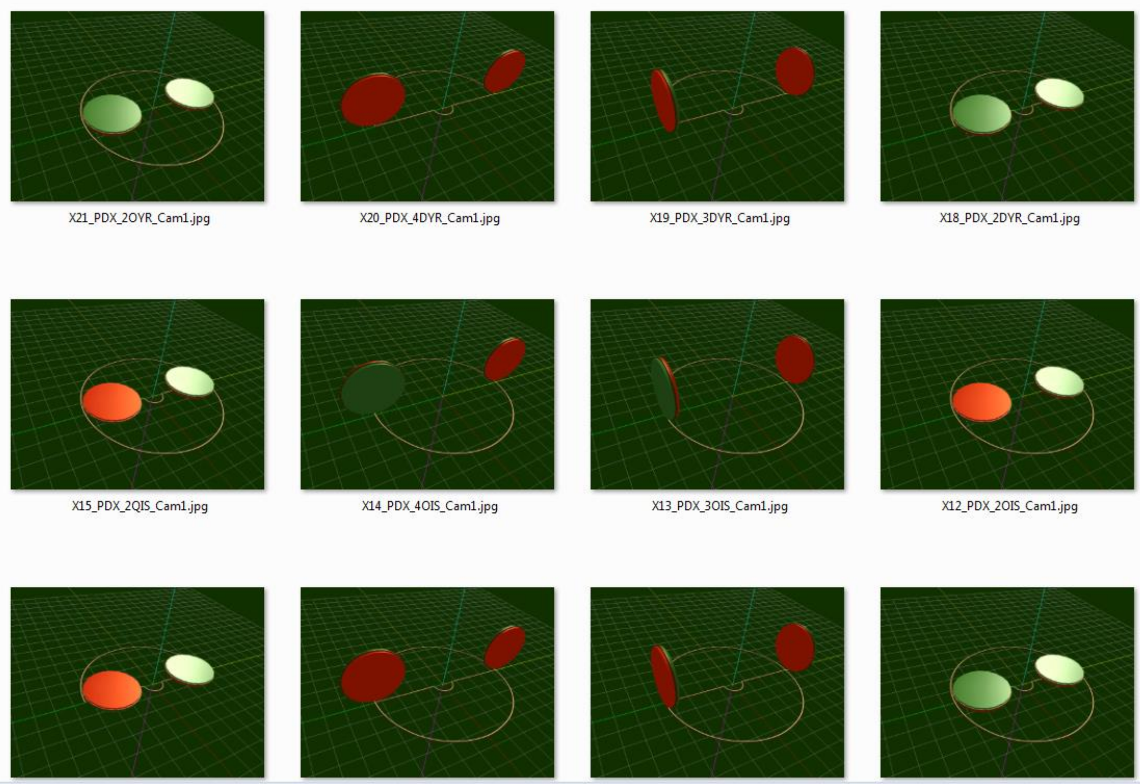
7.2 Paradox 2-4: Rotating Magnetic Systems

The lessons learned from PDX1 include the need for more experimental diversity. Introduced are the Paradox 2 (PDX2), Paradox 3 (PDX3) and Paradox 4 (PDX4) experimental series. For a more complete description see reference [PDX234]. The Paradox number represents the Magnet orientations relative to the axis of rotation indicated by the white arrows.



7-3: PDX Magnet Configurations

For each Paradox series (number) there are 18 different variations. The variations include magnet polarity inversions as well as different loop geometries. The loop geometries include the D-loop (shown), the O-loop and the Q-loop. Each of these loop configurations are simulated with the loop stationary and with the loop rotating with the experiment. This diversity results in a total of 54 unique experiments with some of the configurations shown in the following screen capture.



7-4: PDX Variations (not all shown)

The experiments have the magnets rotating about the axis of rotation while an oscilloscope measures the signals induced in the loop. The following chart shows an abbreviated way to represent the results of all 54 experiments. The X-axis is the experiment number shown in column "idx" in the partial table to the left. This value also used in the filenames of the jpeg pictures above, shown as the 'X' field.

idx	n	Title_Label	MaxIndex	MaxValue
0	10	PDX_2DYS	7	5.49E-16
1	10	PDX_3DYS	0	-0.00156
2	10	PDX_4DYS	3	-0.00137
3	10	PDX_2OYS	2	-1.10E-15
4	10	PDX_3OYS	1	1.73E-18
5	10	PDX_4OYS	9	-5.51E-18
6	10	PDX_2QYS	1	1.45E-18
7	10	PDX_3QYS	3	-8.99E-07
8	10	PDX_4QYS	2	-3.08E-12
9	10	PDX_2DIS	0	-0.00467
10	10	PDX_3DIS	8	3.89E-13
11	10	PDX_4DIS	0	-3.70E-08
12	10	PDX_2OIS	3	-2.28E-18
13	10	PDX_3OIS	3	-7.79E-13
14	10	PDX_4OIS	0	-7.40E-08
15	10	PDX_2QIS	9	-4.16E-06
16	10	PDX_3QIS	0	-5.68E-19
17	10	PDX_4QIS	8	-9.98E-13
18	10	PDX_2DYR	0	5.53E-19
19	10	PDX_3DYR	1	-8.99E-07
20	10	PDX_4DYR	6	6.13E-19
21	10	PDX_2OYR	8	-1.05E-18
22	10	PDX_3OYR	5	-1.99E-18
23	10	PDX_4OYR	0	1.30E-18
24	10	PDX_2QYR	1	7.97E-19
25	10	PDX_3QYR	7	-8.99E-07

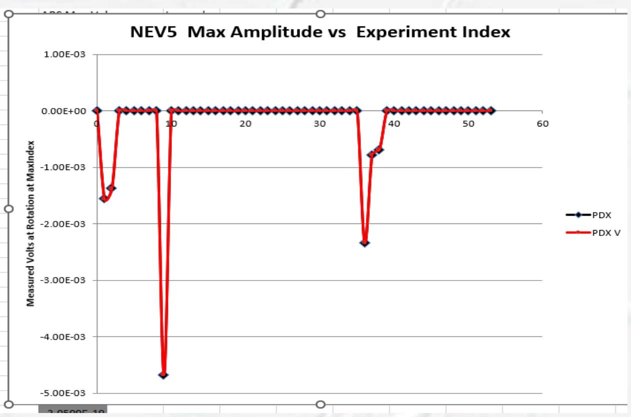


Figure 7-5: PDX 2, 3, and 4 Simulation Results

The experiments are driven by stepper motors with 200 steps per rotation. Correspondingly, the simulation software was setup to simulate 200 points around a complete rotation. To save computation time, the experiments are configured such that the maximum magnitudes are obtained within the first 10 points of rotation. The chart plots the maximum values in the Y-axis while the table shows the maximum value along with the rotational index where the maximum was detected. The values are all negative going because of the choice of magnet orientations and spin direction.

The chart shows the results for NEV5 as the black trace while the expected values (Validation) are the red trace. Classical--E produces identical results while Classical--N and NEV3 fail.

The reason why the majority of configurations produce null results lies in the fact that over half the experiments rotate all the components together to validate that the models do indeed obtain null results.

This discussion is continued in an online video [PDX234] that goes into exhaustive detail about the naming convention, the physical dimensions, etc. The video also show experimental results for the few configurations that produce signals.

TODO: comparison between Classical--E and NEV5 over the differences in contributions per component as was done in the PDX1.

7.2.1 The Importance of Coriolis Charge motion

The results in Figure 7-5 represent the summation of the Magnetic interfragmentary vim (section 3.1.3) and the Coriolis Charge motion effects (section 4.2). The importance of the coriolis charge motion is appreciated by removing it from the Fizzix2 result by commenting out the contributions in the Fizzix2 software (see Figure 7-6). Figure 7-7 shows the disastrous results of the PDX2-4 experiment simulation (black trace) with regard to correct values (red trace).

```
    // Inductive effects
    rtn.F5-=vVector3D.legacyDotProduct((IIdLs/d), dLT);

    // Magnetic effects (expected)
    vMatrix3D IdLsRd = (IdLs/R)/d;
    rtn.F4+=vVector3D.legacyDotProduct(IdLsRd*(Vtw-Vsw),dLT);

    //Coriolis
  //  vVector3D CoriolisPartial = vVector3D.from(source.CoriolisQsAs_pm*dS);   // QsAs per meter of so
  //  rtn.F3-=vVector3D.legacyDotProduct((CoriolisPartial/d), dLT);
```

Figure 7-6: Coriolis Effects Omitted

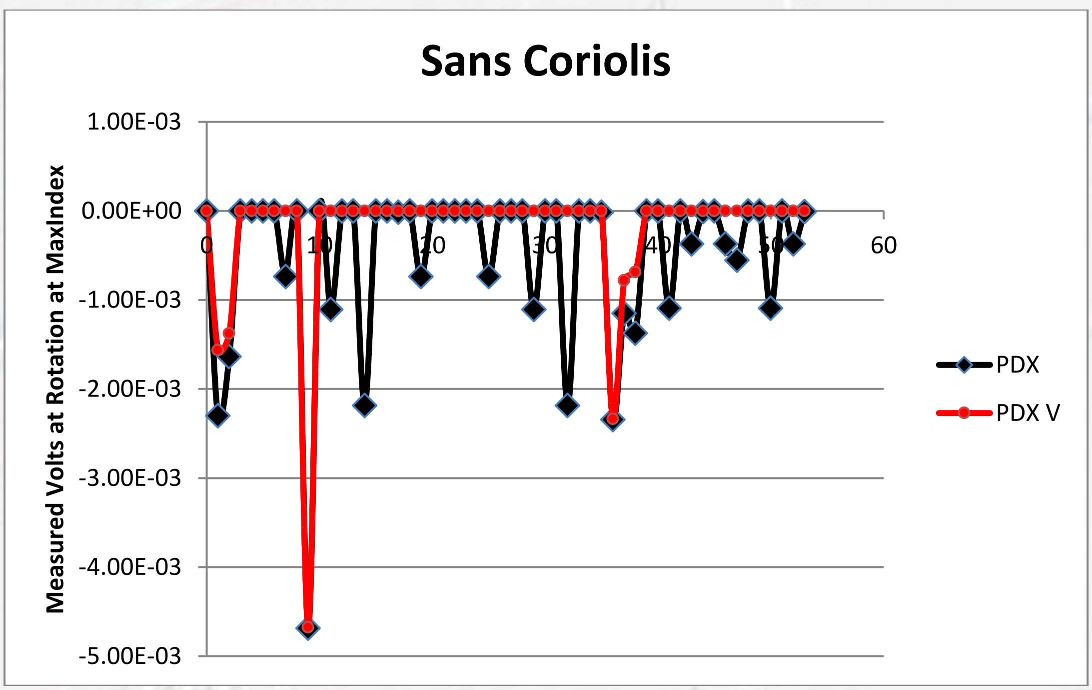


Figure 7-7: PDX2-4, Sans Coriolis

The results show the importance of properly accounting for all the charge motion effects

7.3 Other Experiments

NEV5 will be challenged experimentally until it fails to match observation. At that time, the search for NEV6 commences. Because this paper must be concluded, the ongoing experiments and demonstrations are to be released as supplements. Some experiments are Fizzix2 simulations of already well know experiments. Other experiments are designed to magnify and measures the weaker effects (Centripetal, Venturi) to Corroborate or Invalidate NEV5. Either way, progress is being made.

Classical--E theory is in criminal violation of the Rules of Acquisition (Section 8) and fails at self-inductance and radiation modeling (future supplement). Furthermore, Classical--E cannot be unified with Gravity and Inertia like NEV5 can. Although Classical--E cannot be a candidate for a Theory of Everything, it is still valuable for the purpose of experimental economization. When NEV5 and Classical--E agree on an experimental simulation, this will be considered experimental validation for the purpose of reducing time/money spent on experiment design, fabrication, and testing. It is feared that this decision will come back to haunt the EM project; however, time is short, emphasizing the need to economize where ever possible.

The complete list and description of experimental supplements will be posted at www.Distinti.com when they become available.

8 Classical--E and the Rules of Acquisition

It should be clear from the data presented in this paper that the legacy scientific paradigm of "proving" a theory "true" through positive experimental outcomes, known as verification theory, is impractical. This is evident from the data presented in Section 7.1 which shows 4 scientific theories that produce identical results for the measurable values. One may try to argue that identical results indicate that these models must be the same model, just in different forms. This argument is incorrect because the components that add up to produce the results are unique; therefore, the theories are unique.

"Logically, no number of positive outcomes at the level of experimental testing can confirm a scientific theory, but a single counter example can show a theory to be false." – Karl Popper.

Popper's falsification theory is just as impractical as the verification theory of science. The falsification theory requires that for a theory to be considered scientific, it must be testable with the potential to be proven false by counterexamples. For example the hypothesis that "No bears are white" is falsified by the observance of a polar bear. But what if you lived in ancient times when the footprint of humanity was so small that no-one had ever seen a polar bear. It may take thousands of years for technology to advance to expand humanity's footprint for the counterexample to be discovered. The hypothesis may be scientific by Popper's point of view but that provides us no help in improving science because we are still at the mercy of counterexamples which may exist but we may never encounter. Something more is needed.

"We should not think that a theory is ultimately true, only that no counterexample has yet been found" – Imre Lakatos

Verification theory requires complete knowledge of everything past, present, and future in order to prove that a theory is valid under all conditions and all times. Essentially, verification theory tries to prove that no counterexamples exist. Falsification theory is really the same theory stated in reverse because complete knowledge of everything past, present and future is required to find the counterexample to prove that a theory isn't true. Humanity will never have complete knowledge, what we have is an ever increasing footprint of knowledge. Under the present scientific method, the best we can hope for is a bunch of dubious scientific theories waiting around for counterexamples to prove them wrong. This is a ridiculous conundrum that is stagnating science. Because if the existing scientific theories which are the foundation of the technology used to expand the footprint are gibberish, then the technology needed to expand the footprint may never arise. Without the technology, the footprint will not expand and the counterexamples will not be found. Stagnation will reign for generations while scientists claim that their theories have never been proven wrong therefore, they are irrefutable. The most crippling refrain in science will be uttered as a means to excuse the lack of progress "If science was wrong, someone would have said something by now". This phrase results from poor scientific training that leads to disastrous behavior where when confronted with a counterexample, no one will say anything, ever. The full story behind this damaging phrase and its fallout are covered in the 27th Rule of Acquisition: The Smarter Monkey Fallacy.

"The greatest obstacle to science is the illusion that we think we know what we are doing"—Dr. David Disney.

8.1.1 Distinti's Rules of Scientific Acquisition

The Rules of Acquisition are a toolset of approximately 36 Rules, Tells, Imperatives, Fallacies, Dualities and others that expose faults in models, theories and humans. Faults that can be exploited NOW rather than waiting for counter examples to appear a thousand years from now. This will supercharge scientific progress.

The toolset was developed because science needs more than counterexamples as a means to judge theories and models. Some of the tools are improvements over existing rules such as Conservation of Energy, Locality; however, these rules are anemic and generally ignored by scientists. For example Maxwell's Plane Wave Equation violates conservation of energy and Quantum Entanglement violates Locality but nobody seems to care. There are even counterexamples that are frivolously ignored because it is not good for career or prestige to claim that Maxwell or Einstein was wrong (especially if the claim turns out to be in error). So not only is there a need for a means to judge theories, there is also a need for a means to alter human behavior to embrace failure and tolerate mistakes made by others so as not to discourage people from sharing what they perceive as rule violations or counterexamples. Otherwise scientists become sycophants to the collective while those who question the collective are made examples of by being cancelled, squashing any incentive, for anyone, to bring forth counterexamples. Therefore, counterexamples never see the light of day and stagnation permeates. This is the situation today.

The above is an introduction to the Fifth Edition of the Rules of Acquisition (ROAV5). There are older versions of the ROA which were never formally released because the tool set has been evolving quickly. It began as a series of 30 aphorisms and has matured into over 200 aphorisms grouped into 36 rules. The Fifth Edition is stable enough to warrant a dedicated paper and video series.

The remainder of this section demonstrates some of the infractions of the ROA by the Classical--E magnetic field model.

Figure 8-1 shows a disc magnet with its north side up (facing reader). According to Classical theory, there is a plurality of flux lines emanating from the top of the magnet curling back and penetrating the diagram all around the magnet. This discussion focuses on one flux line which penetrates the diagram at the location of the **X** marked **a**. If the magnet were rotated, the flux line moves along the red dotted path. Upon completion of rotation, the flux line penetrates at location **b**. If there were a conductor present (orange fragment) along the path, the crossing of the flux line through the conductor would induce vim (emf).

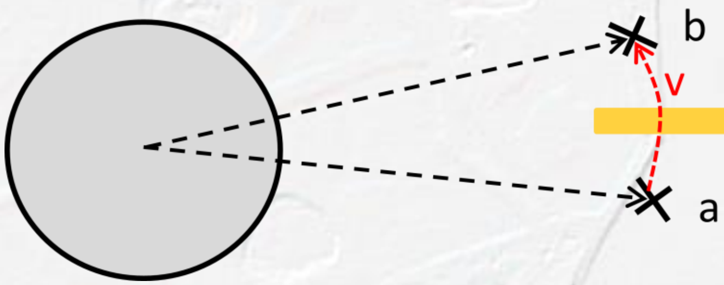


Figure 8-1: Classical--E: Magnetic Field Line of a rotating magnet

So a magnetic field must be a static construct that somehow knows how to change position when the magnet moves. If the magnet were replaced with a coil of wire carrying a current, then how does one explain a static construct generated by moving charges? If the flux lines are generated by moving charges but their location is dictated by some other part of the magnet, then there is a violation of the 25th Rule of Acquisition: The Locality Tell.

The Biot-Savart model does not provide for flux line location, velocity or acceleration, it only describes flux line direction and density. Relative motion between a conductor and magnetic are required for an effect and contradictory, the model of the magnetic field is ambiguous to field motion. This is a violation of the 17th Rule of Acquisition: The Ambiguity Tell. Furthermore, there is NO OTHER EMISSION of any other known field that could convey the knowledge of the magnet rotation to the flux lines. This is a violation of the 16th Rule of Acquisition: the Causality Tell.

The flux lines, when crossing the conductive fragment impart energy in the form of vim (emf). This can only occur flux lines contain energy. Since classical scientists do not believe in a medium for the conveyance of field energy, then flux lines must be made from something. It is not sufficient to claim that flux lines are made from energy because the accepted definition of energy is a two-body phenomenon which is meaningless for a single body. For example, a projectile has the kinetic energy $1/2MV^2$. To an observer moving with the projectile there is NO KINETIC ENERGY; therefore, a single body observing itself sees no kinetic energy. So energy (as defined) is a difference in state between two bodies and therefore cannot exist on its own; therefore, the precursor to energy is the state of a single body or medium. So when the current in a loop is increased and the number of flux lines in the magnetic field increase, some material must be “created” (or pulled from somewhere else) that can hold a state for imparting kinetic energy to charges. So what is this material, where does it come from? Where does this material go when the current is removed? This is a violation of the 14th Rule of Acquisition: The Conservation Tell.

Finally, by increasing the current in the loop, the density of flux lines increase at all locations. How do these new static structures get there? The best explanation describes an expanding magnetic field when the current is increased and a collapsing magnetic field when the current is reduced. But if newly created flux lines near the wire somehow push against existing field lines causing the whole field to expand outward, then it would require that flux lines interact with each other meaning magnetic fields are not linear and crossed light beams would interfere with each other instead of passing through each other. There is no explanation how newly minted flux lines appear at a given distance from a source, so this is a violation of Causality (16) and Locality (25).

The Biot-Savart model requires an arbitrary constant of relation μ_0. Arbitrary Constants of Relation (ACOR) fall under the 24th Rule of Acquisition: The Arbitrary Tell. Essentially, if you know what you are doing then nothing should be arbitrary. Science has tried to feign knowledge by claiming that this value represents the vacuum permittivity. Let’s restate what is going on so it will become clear: Scientists measure how one charge affects another over a distance using completely arbitrary units of measure and assume the ACOR is due solely to the properties of empty space? Think about how stupid that is. There is a long argument that will be saved for the publication of the 24th rule. Essentially, if the arbitrary units of measure are properly ascribed (no over subscription, redundancies, doppelgangers, or missing values), there should be no arbitrary constants in a Theory of Everything because everything should be folded into the arbitrary units of measure for the same reason there is no arbitrary constant for F=MA or ohms “law”. To be clear, there can be constants as long as they are not arbitrary. Non-Arbitrary constants are called Normal constants in Ethereal Mechanics. They are normal because their origin and meaning are known.

In Ethereal Mechanics, the constant μ_0 is part of the conversion constant K_M which is used to convert from natural inertial (square coulombs per meter) to the legacy inertia (kilograms). The constant K_M has the units of kilogram/(square coulombs per meter). The kilogram is oversubscribed in classical science, representing both inertia and the quantity of stuff. This oversubscription is the cause of the unnecessary arbitrary constants of classical theory. NEV5 has no ACORs and K_M (which is no longer arbitrary) is used only to convert between natural and legacy units for compatibility with legacy instruments.

Another example of an arbitrary constant of relation is the gravitational constant G. It is acknowledged as completely arbitrary in mainstream science because scientists have not made fools of themselves by trying to claim it is some property of the vacuum like they did for Classical theory. The constant G is normalized in Electrogravity [EM03] where it is derived from more fundamental properties of the model of matter. Assuming the derivation is correct; the origin and meaning of the constant G is now understood, so it is now a normal constant. The constant G is just a simple abstraction that condenses the contributions from the underlying mechanisms.

Many ROA violations of classical theory are shown; however, it only takes a single violation of the Rules of Acquisition to disqualify a theory/model as a candidate for a Theory of Everything (TOE).

The Ethereal Mechanics field mechanism is an emissive model which provides correct answers without violations of the ROA. This emissive model requires a medium (the Ether). The magnetic field is generated by charges moving relative to the medium causing a disturbance (state of the medium) that propagates away. A magnetic field from a magnet or loop of wire is a complex tapestry of magnetic fields from all the different motions of all the charges as demonstrated in chapters 3 and 4. NEV5 presently has no graphical abstraction to pictorially represent a magnetic field like the flux line abstraction of classical theory.

A simulation that enables one to visualize an emissive field is shown in Figure 8-2. The yellow circle represents a generic emission source (not necessarily an electromagnetic source). The source disturbs the medium in some way. The dots emanating from the side of the source, represent states of the medium, caused by the disturbance, that propagate away (not move). Emissions occur over the entire volume of the source but are only shown from a few points to prevent the picture from being too busy.

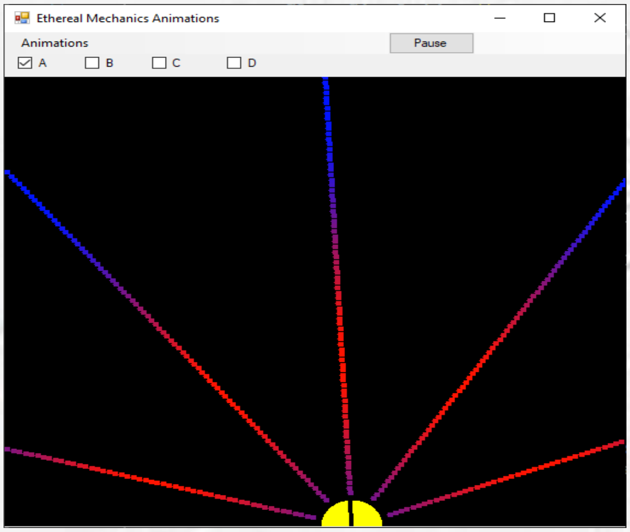


Figure 8-2: Generic Emission Model: Static Source

It is easy to see how an emissive field could appear as a static phenomenon just as the street light example in section 1.9.

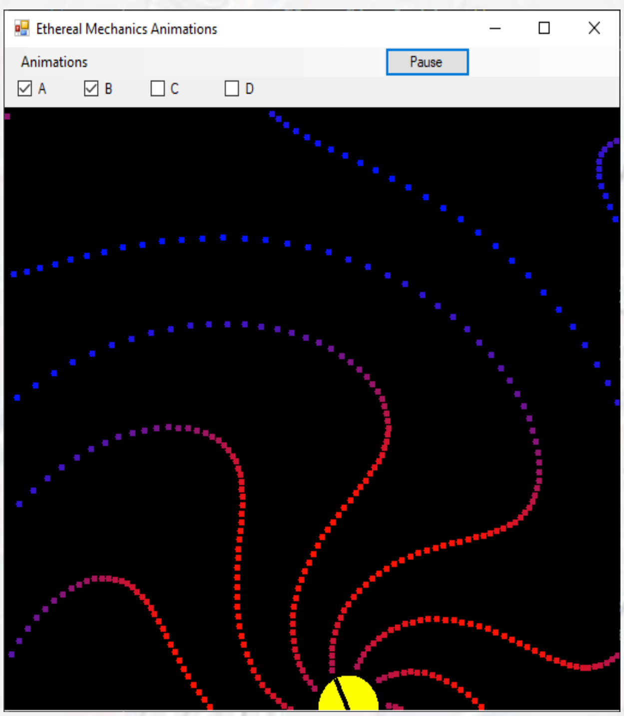


Figure 8-3: Generic Emission Model: Rotating Source

If the source were rotating left and right in a sinusoidal fashion, the emissions would take on the curved shapes shown in Figure 8-3. This is analogous to the paths taken by water droplets emanating from an oscillating sprinkler head. Although each state is propagating away from the rotating source a straight line, that state will contain information about the rotational state of the source at the time of emission.

This model does not violate any of the Rules of Acquisition. The states propagate away forever. Since the propagating states carry the information about the state of the source to all distant points, there is no violation of locality or causality. This is in contrast to the static field models which do not explain how the distant field lines are updated with knowledge of a state change of the source or how the field lines get there in the first place.

9 Conclusion

New Electromagnetism Version 5 (NEV5) expresses electromagnetic interactions for experimental and engineering applications with the following properties.

1) No Violations of the Rules of Acquisition
    a. No Arbitrary Constants of Relation (ROA24)
    b. No Ambiguity (ROA17)
    c. No Over Subscription (ROA14)
    d. No Violations of Locality (ROA25)
    e. No Violations of Causality (ROA16)
    f. No Wrong Answers (ROA2) (so far)
    g. No Paradoxes (ROA9)
    h. Etc.
2) Expression of effects that Classical theory is oblivious to
    a. Coriolis Charge Motion
    b. Centripetal Charge Motion
    c. Venturi Charge Motion
    d. Inertial Field
3) Solutions to effects that are not possible with classical theory
    a. Inductance of open loop (dipole) and closed loop inductors
    b. Inductance of conductive traces against a ground plane
    c. Inductance of conductive traces sandwiched between two ground planes
    d. Actual intensity and direction of force within inductors.
4) Superior Models of
    a. Conductors
    b. Magnets
5) Derived with Vortrix Algebra, the most complete form of mathematics to date
    a. Unifies all mathematics
        i. Complex numbers
        ii. Vectors
        iii. Quaternions
        iv. Matrices
    b. Provides the only complete vector multiply and divide in mathematics
        i. No dimensional violations
    c. Compliant with the Rules of Acquisition
6) The first electromagnetic theory derived from a singular underlying fundamental field
    a. The Pretonic Field (see Electrogravity)

NEV5 represents a magnum leap forward in electromagnetic theory. Ignore this at your own peril.

Ethereal Mechanics: Cosmology [EM05] follows next which develops that large scale Ether model and applies it to Black Holes, Planetary Precession, Stellar Aberration, and Galactic Behaviors without the need for Dark Matter.

Appendix A. Abbreviations

ACOR	Arbitrary Constant of Relation
AE	Advanced Ether Model
BS	Biot-Savart magnetic field model of classical theory
CE	Classical Electromagnetism (Electrodynamics)
EM	Ethereal Mechanics
emf	Electro Motive Force, the term used for vim in legacy theory or early New Electromagnetism
F-F	Fragment-To-Fragment, interfragmentary
F-P	Fragment-To-Point
FWM	Fragmentary Wire Models
GR	General Relativity
HFSWM	High Frequency Solid Wire Models
J-F	Junction-To-Fragment
J-P	Junction-To-Point
LFSWM	Low Frequency Solid Wire Models
L-P	Loop-To-Point
LSE	Large Scale Ether Model
LU	Legacy Units
LVA	Legacy Vector Algebra
MOM	Model of Matter
MORC(s)	Members of the Relativity Community
NE	New Electromagnetism
NE3,NEV3	New Electromagnetism Version 3
NE5,NEV5	New Electromagnetism Version 5
NEP	New Energy Paradigm
NU	Natural Units
PDX	Abbreviation for the Paradox Experiments
P-P	Point-To-Point
QM	Quantum Mechanics
ROA	Rules of Scientific Acquisition
ROAV5	Rules of Scientific Acquisition Version 5
SOP	System of Pretons
SOSOP	Second Order System of Pretons
SSE	Small Scale Ether Model
SSG	Small Scale Gravity
SWM	Solid Wire Models
TOE	Theory of Everything
VA	Vortrix Algebra
V_K	Kinetic Voltage, the term used for vim in NEV3 and later.
W-W	Wire-To-Wire

Appendix B. Definitions

Up The Rabbit Hole Down the Rabbit Hole	Down the Rabbit hole is a euphemism that refers to going to the deeper constructs that comprise the present context. For example, if one were looking at a JPG image, then going down the rabbit hole would be to look at the compression algorithm or even consider the format of the image at the binary level. This expression was made popular by the movie "The Matrix" and it is a reference to Lewis Carol's "Alice in Wonderland" Up The Rabbit Hole is the opposite.
Preton	Inertialess charge particle (formerly MCP massless charged particle)
MOM, SOP, SOSOP	The basic model of matter (MOM) in Ethereal mechanics. SOSOP is an acronym for second order system of pretons. The shorter version is just SOP which is system of pretons.
Transvariance	Variations in natural processes occurring as the result of a body translating with respect to the medium (see [EM01]). These variations allow experimental results to yield the same answer regardless of the experimental velocity relative to the medium (e.g. Michelson Morley). These variations include length contraction, changes in reflection and refraction, changes in field emission geometries, process dilation (formerly called time dilation) and others. This is the first paper of Ethereal Mechanics and it supersedes Special Relativity.
Natural Units	Physical units represented without arbitrary constants of relation (ACOR). These allow the structure of the underlying physical systems to express themselves. This is the subject of the second Ethereal Mechanics Paper [EM02]
Vortrix Algebra (VA)	Vortrix Algebra is an improved Vector algebra that provided a more complete multiply (product) and the first ever vector quotient. Vortrix Algebra is defined for System of 1 dimension (Arithmetic), 2 dimensions supersedes complex algebra without the need for an imaginary operator and 3 dimensional systems. VA is capable of systems of any number of dimensions; however, the complexity grows by an order of magnitude for each additional dimension.
Rules of Acquisition	The Rules of Scientific Acquisition are a series of aphorisms that guide scientific thinking. There are Tells that allow better fidelity in knowing whether a model or theory is hiding something more fundamental. There are Rules and Imperatives to ensure more a more complete scientific examination of natural phenomenon. There are Traps (Mind Traps) and Fallacies to expose flaws in human thinking and behavior that impair scientific progress.
Far Field	Far enough away from a SOSOP that the orbital radius (r_O) of the SOSOP does not materially affect the field ($d>>r_O$). A criteria has not been established; however, $d= 1000r_O$ has been used successfully in computer simulation.
Classical--E	Einstein was the first to formally declare that a magnetic field must move/rotate with the magnet. This requires additional variables and considerations that are not found in the classical models; however, consideration of the B-field velocity and rotation is done by fiat. This model provides excellent results for all the paradox experiments; however, the contributions to the result are different than NEV5. This consideration of magnetic field motion violates many of the Rules of Acquisition see section 8.
Classical--N	Classical theory applied with no-consideration of the velocity/rotation of the magnet itself. Combining Biot-Savart with F=QVxB is a common practice that results in a line-of-sight (LOS) model (see derivation below) which is more compliant with the Rules of Acquisition.

	$\mathbf{B} = K_M I_S \frac{d\mathbf{L}_S \times \hat{\mathbf{r}}}{r^2}$ $\mathbf{F} = Q\mathbf{V} \times \mathbf{B}$ $\mathbf{F}_T = \frac{K_M I_S Q_T}{r^2} \mathbf{V}_T \times \left(d\mathbf{L}_S \times \hat{\mathbf{r}} \right)$ $\mathbf{F}_T = \frac{K_M Q_S Q_T}{r^2} \mathbf{V}_T \times \left(\mathbf{V}_S \times \hat{\mathbf{r}} \right)$ $\mathbf{F}_T = \frac{K_M Q_S Q_T}{r^2} \left(\left(\mathbf{V}_T \bullet \hat{\mathbf{r}} \right) \mathbf{V}_S - \left(\mathbf{V}_T \bullet \mathbf{V}_S \right) \right) \hat{\mathbf{r}}$ This model gives excellent results for the Paradox 1 Experiment; however, it fails the other Paradox Experiments
Fizzix2	A C# based software modeling tool developed by the author for simulating electromagnetic interactions suitable for electrical engineering/ experimental simulation. Fizzix2 allows multiple rotational/translations reference frames to be nested to model complex rotational interdependencies. This tool replaces the original Fizzix software (now called Fizzix1) which was only designed to do translation experiments and was augmented to do a single rotational reference frame aiding in the search for NEV5.
Vim, Vimage	Kinetic Joules per coulomb. Replaces the term emf from classical theory and the symbol V_K (Kinetic Voltage) from NEV3 and later. Vim is square ampere meters per coulomb (natural volts per coulomb)
Coulombic System	A System of Pretons that expresses the Coulomb Field (Section 1.7)
Charge of a Coulombic System	The Total Pretonic Charge of a Coulombic System (Section 1.7)
Coulombic Charge	Either the pretonic charge of a coulombic system or the coulombic system itself (Section 1.7) or both.
q (as variable)	Model Specifies Coulombic Charge only
Q (as variable)	Model Specifies Coulombic or Pretonic Charge
Junction Modeling	Modeling of an effect that occurs over such a small distance that it can be treated as a point emission. This is typically applied to charge acceleration that occurs at the junction where wires of dissimilar properties meet. Another application occurs at the location where wire change direction (the dissimilar property at the junction being direction)
Mutual Inductance	
Self Inductance	
Diminishing operator Differential operator	
Interfragmentary	

Appendix C. References

[PDX1] Paradox 1 Experiment video
https://youtu.be/8D6VaoEeRt8

[PDX234] Paradox 2, 3, 4 Experiment Video
https://youtu.be/StgFwCgJcjc

[EM01] Transvariance. The first Ethereal Mechanics paper Ver 1.2, 25 Dec 2018
Copyright Registration Number TXu 2-125-035, 20 Nov 2018
https://www.distinti.com/tv.html
https://www.distinti.com/docs/EM_01_Transvariance_ver1_2.pdf

[EM02] Constructs. The Second Ethereal Mechanics paper Ver 3.1, 21 Sep 2021
Copyright Registration Number TXu 2-261-518, 23 May 2021
https://www.distinti.com/docs/EM_02_Constructs_V3p1.pdf

[EM03] Electrogravity. The Third Ethereal Mechanics paper Ver 1.1, 14 Aug 2022
Copyright Registration Number TXu 2-326-667, 15 May 2022
https://www.distinti.com/eg.html

[VA] Vortrix Algebra Ver 1.3. More complete vector algebra that includes proper product and quotient
https://www.distinti.com/va.html

[ROA] Rules of Scientific Acquisition
https://www.distinti.com/roa.html

[EM03] Electrogravity Home Page
https://www.distinti.com/eg.html

[EM04,NEV5] New Electromagnetism V5
https://www.distinti.com/ne5.html ← Posted here when release

[EM05] Cosmology The fifth Ethereal Mechanics Paper (Future release)
https://www.distinti.com/cosmo.html ← Posted here when released – check for release date updates

[EM06, NEP] New Energy Paradigm – Continuation of Electrogravity
https://www.distinti.com/nep.html ← Posted here when released

[NE3, NEV3] New Electromagnetism V3 (obsolete except for New Induction)
https://www.distinti.com/ne.html

[FOUND] The Foundation Video Series – the development of New Induction and New Gravity
https://www.distinti.com/fs.html

[THESIS] Graduate Thesis using New Induction
https://www.distinti.com/docs/neThesis.pdf

[NG] New Gravity, Distinti 1999 (revised 2004)
https://www.distinti.com/docs/ng.pdf

[NIA1] New Induction Applications Volume 1, Distinti 2003 (revised 2007)
https://www.distinti.com/docs/nia1.pdf

[NM] New Magnetism, Distinti 2003 (revised 2007)
https://www.distinti.com/docs/nm.pdf

[T1] 500c or Die – We must break the light barrier by a factor of 500 or face extinction
https://www.youtube.com/watch?v=HS-gkF2nQio

[T13] Prior Art Review
https://www.youtube.com/watch?v=M8OR7LqUpio

[EMG02] Review of Ampere's Force Model – Physicists had the link to the TOE and threw it out
https://youtu.be/ziLMIs3mo-k

[EMG02] Review of Webber's Force Model
https://youtu.be/2eMFqxWyOxY

Supplements
[https://www.youtube.com/watch?v=_LWXeFIT-4g] Transvariance Simulation Video

[https://www.patreon.com/posts/22830195] Transvariance Simulation Executable (Win7 and above)

[https://www.youtube.com/watch?v=vBgdiAij1gA] Derivation of Transvariant Steering

[https://www.youtube.com/watch?v=YssguP9OIAI] Derivation of Transvariant Emission

Appendix D. The Anomaly

This is a continuation from section 3.1.1 where the magnetic Fragment to Point model is derived

$$\mathbf{F}_T = Q_{SC} Q_T \frac{\left[(\mathbf{V}_{SC} + \mathbf{V}_{SW}) / \hat{\mathbf{r}}\right]\left(\mathbf{V}_T - \mathbf{V}_{SC} - \mathbf{V}_{SW}\right)}{|\mathbf{r}|^2}$$

The V_{SC} term highlighted in red represents an anomaly. The short term resolution is to eliminate this term from the expression. The justification of this is that the parenthesis containing this term represents the derivative of **r** which is the rate at which the fragment is closing with the point charge. This is confirmed observationally because it is well known that a loop containing a current does not affect a point charge unless the relative position of the loop and the point charge change; therefore, the velocity of the conduction charges at the fragmentary level do not contribute to the relative distance term and should be eliminated. A second way to verify that this term should not be part of the equation is to complete the derivation from section 3.1.3 without discarding this term and compare the results against experimental results. This is the procedure in the remainder of this appendix

The long term solution requires us to reconcile this foundationally so that term does not express itself in the first place. The possibilities are:

1) Does the derivative of a Vortrix vector have details that are yet undiscovered?
2) Is this canceled by the missing set of forces theorized in Electrogravity?
3) Is this cancelled by the Electric Force model which now contains a velocity component?
4) Is this related to the missing components of the electric force model (See Electrogravity)?

Ultimately, this anomaly must be answered as it should possibly be a rabbit hole that will show us more detail about the working of nature that we still don't understand.

The good thing is that the final Vortrix expressions that give experimentally accurate answers are known so at least we know what the destination looks like.

For the purpose of thoroughness, the Vortrix derivations are done here with the V_{SC} term left in. The following derivations follow the same logic as section 3 but may be missing the connecting text to explain the steps. At the end of the appendix, the Fizzix2 Simulation results of Paradox experiments using the Vim result. It should be noted that the Fragment to Fragment Force model is unaffected by the V_{SC} term and yields the same results as section 3.

Magnetic Force: Fragment to Point

Starting with the Magnetic force model expressed in terms of the conduction charges.

$$\mathbf{F}_T = Q_{SC} Q_T \frac{\left[(\mathbf{V}_{SC} + \mathbf{V}_{SW}) / \hat{\mathbf{r}}\right]\left(\mathbf{V}_T - \mathbf{V}_{SC} - \mathbf{V}_{SW}\right)}{|\mathbf{r}|^2}$$

Next, the Magnetic force model is expressed in terms of the uncovered/unbalanced charges.

$$\mathbf{F}_T = Q_{SU} Q_T \frac{\left[(\mathbf{V}_{SW}) / \hat{\mathbf{r}}\right]\left(\mathbf{V}_T - \mathbf{V}_{SW}\right)}{|\mathbf{r}|^2}$$

Remembering that QSU = -QSC, the above two expressions are combined for the total force on the target

$$\mathbf{F}_T = Q_{SC}Q_T\left(\frac{\left[(\mathbf{V}_{SC}+\mathbf{V}_{SW})/\hat{\mathbf{r}}\right](\mathbf{V}_T-\mathbf{V}_{SC}-\mathbf{V}_{SW})}{|\mathbf{r}|^2} - \frac{\left[(\mathbf{V}_{SW})/\hat{\mathbf{r}}\right](\mathbf{V}_T-\mathbf{V}_{SW})}{|\mathbf{r}|^2}\right)$$

Begin by determining the Quantity of source conduction charge

$$Q_{SC} = Q_{SPM}\left|d\mathbf{L}_S\right|$$

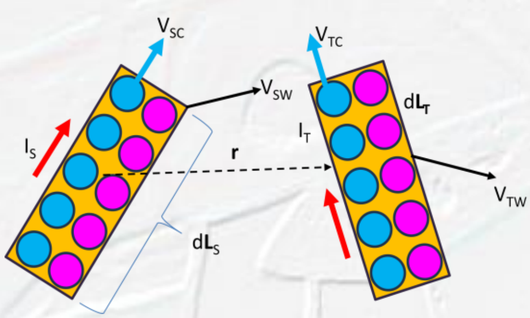
Next, the Point-To-Fragment conversion identity with subscripts suitable fr the conduction charge

$$\mathbf{V}_{SC} = \frac{I_S d\mathbf{L}_S}{Q_{SC}} = \frac{I_S d\mathbf{L}_S}{Q_{SPM}\left|d\mathbf{L}_S\right|} = \frac{I_S d\hat{\mathbf{L}}_S}{Q_{SPM}}$$

$$dd\mathbf{F}_T = Q_{SPM}\left|d\mathbf{L}_S\right|Q_T\left(\frac{\left[\left(\frac{I_S d\mathbf{L}_S}{Q_{SPM}\left|d\mathbf{L}_S\right|}\right)/\hat{\mathbf{r}}\right]\left(\mathbf{V}_T - \frac{I_S d\mathbf{L}_S}{Q_{SPM}\left|d\mathbf{L}_S\right|} - \mathbf{V}_{SW}\right)}{|\mathbf{r}|^2} + \frac{\left[(\mathbf{V}_{SW})/\hat{\mathbf{r}}\right]\left(-\frac{I_S d\mathbf{L}_S}{Q_{SPM}\left|d\mathbf{L}_S\right|}\right)}{|\mathbf{r}|^2}\right)$$

$$dd\mathbf{F}_T = \frac{Q_T}{|\mathbf{r}|^2}\left(\left[(I_S d\mathbf{L}_S)/\hat{\mathbf{r}}\right]\left(\mathbf{V}_T - \mathbf{V}_{SW} - \frac{I_S d\hat{\mathbf{L}}_S}{Q_{SPM}}\right) - \left[(\mathbf{V}_{SW})/\hat{\mathbf{r}}\right](I_S d\mathbf{L}_S)\right)$$

Magnetic Force: Fragment to Fragment



$$d\mathbf{F}_T = \frac{Q_T}{|\mathbf{r}|^2}\left(\left[(I_S d\mathbf{L}_S)/\hat{\mathbf{r}}\right]\left(\mathbf{V}_T - \mathbf{V}_{SW} - \frac{I_S d\hat{\mathbf{L}}_S}{Q_{SPM}}\right) - \left[(\mathbf{V}_{SW})/\hat{\mathbf{r}}\right](I_S d\mathbf{L}_S)\right)$$

$$dd\mathbf{F}_{TC} = \frac{Q_{TPM}\left|d\mathbf{L}_T\right|}{\left|\mathbf{r}\right|^2}\left(\left[(I_S d\mathbf{L}_S)/\hat{\mathbf{r}}\right]\left(\frac{I_T d\mathbf{L}_T}{Q_{TPM}\left|d\mathbf{L}_T\right|} + \mathbf{V}_{TW} - \mathbf{V}_{SW} - \frac{I_S d\hat{\mathbf{L}}_S}{Q_{SPM}}\right) - \left[(\mathbf{V}_{SW})/\hat{\mathbf{r}}\right]\left(I_S d\mathbf{L}_S\right)\right)$$

$$dd\mathbf{F}_{TU} = -\frac{Q_{TPM}\left|d\mathbf{L}_T\right|}{\left|\mathbf{r}\right|^2}\left(\left[(I_S d\mathbf{L}_S)/\hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW} - \mathbf{V}_{SW} - \frac{I_S d\hat{\mathbf{L}}_S}{Q_{SPM}}\right) - \left[(\mathbf{V}_{SW})/\hat{\mathbf{r}}\right]\left(I_S d\mathbf{L}_S\right)\right)$$

$$dd\mathbf{F}_T = dd\mathbf{F}_{TC} + dd\mathbf{F}_{TU}$$

$$dd\mathbf{F}_T = \frac{I_S I_T}{\left|\mathbf{r}\right|^2}\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]d\mathbf{L}_T$$

Magnetic Vim: Fragment to Fragment

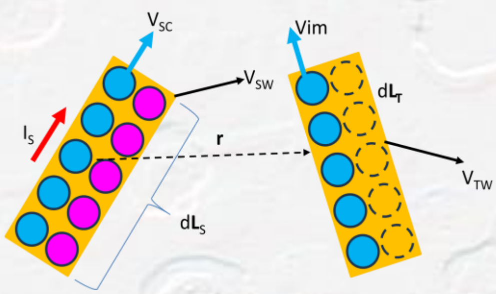


Figure 9-1: Fragment to Vim Parameterization

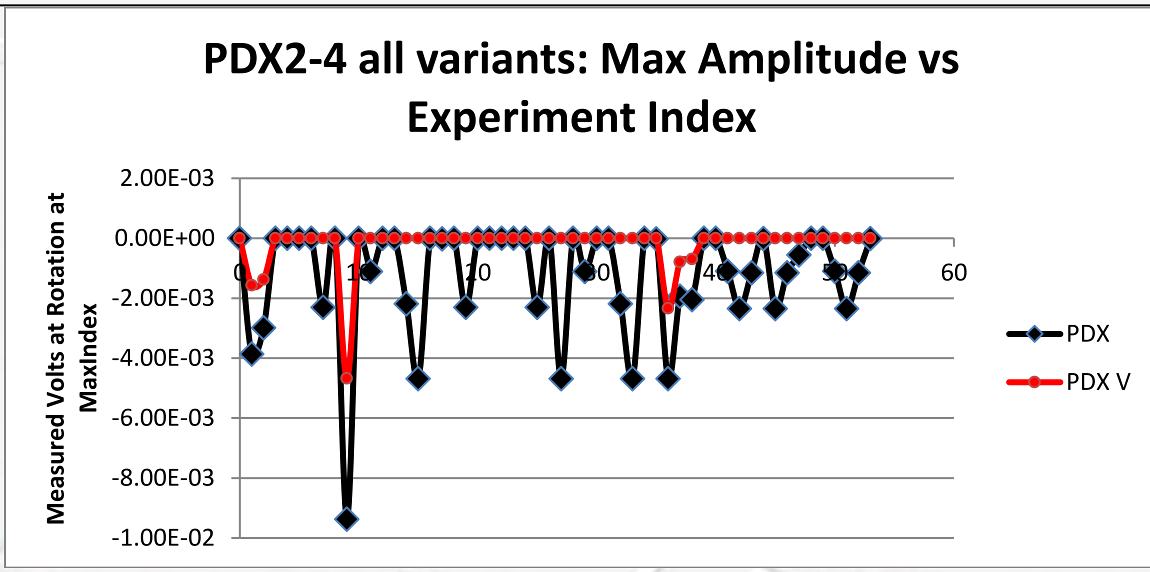
$$d\mathbf{F}_T = \frac{Q_T}{\left|\mathbf{r}\right|^2}\left(\left[(I_S d\mathbf{L}_S)/\hat{\mathbf{r}}\right]\left(\mathbf{V}_T - \mathbf{V}_{SW} - \frac{I_S d\hat{\mathbf{L}}_S}{Q_{SPM}}\right) - \left[(\mathbf{V}_{SW})/\hat{\mathbf{r}}\right]\left(I_S d\mathbf{L}_S\right)\right)$$

$$ddVim_T = \frac{1}{\left|\mathbf{r}\right|^2}\left(\left[(I_S d\mathbf{L}_S)/\hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW} - \mathbf{V}_{SW} - \frac{I_S d\hat{\mathbf{L}}_S}{Q_{SPM}}\right) - \left[(\mathbf{V}_{SW})/\hat{\mathbf{r}}\right]\left(I_S d\mathbf{L}_S\right)\right)\bullet d\mathbf{L}_T$$

$$ddVim_T = \frac{I_S}{\left|\mathbf{r}\right|^2}\left(\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]\left(\mathbf{V}_{TW} - \mathbf{V}_{SW}\right)\right)\bullet d\mathbf{L}_T - \frac{I_S^2}{Q_{SPM}\left|\mathbf{r}\right|^2}\left(\left[d\mathbf{L}_S/\hat{\mathbf{r}}\right]d\hat{\mathbf{L}}_S\right)\bullet d\mathbf{L}_T - \frac{I_S}{\left|\mathbf{r}\right|^2}\left(\left[\mathbf{V}_{SW}/\hat{\mathbf{r}}\right]d\mathbf{L}_S\right)\bullet d\mathbf{L}_T$$

Simulation results

The following chart shows the simulations results for the PDX2, PDX3 and PDX4 experiment variations (a total of 54 experiments). The red trace is experimental results. The black trace is the results of the standard simulation except that the magnetic interfragmentary vim is replaced using the vim model derived in this section. It should be obvious that the inclusion of the anomalous term is incorrect.


PDX2-4 all variants: Max Amplitude vs Experiment Index
Measured Volts at Rotation at MaxIndex
2.00E-03
0.00E+00
-2.00E-03
-4.00E-03
-6.00E-03
-8.00E-03
-1.00E-02
0
10
20
30
40
50
60
PDX
PDX V

Appendix E. Revision History

Rev (Ver)	
5.0 24 Feb 2024	Initial Draft (Registered with copyright office). For Patreon Review