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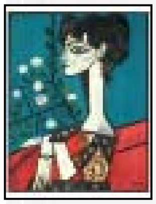
NE V2 Definition: Fragment



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NE V2 Definition: Fragment

This document details a change in the New Electromagnetism definition of “Fragment”. This change is part of the New Electromagnetism Version 2 (NE V2) evolution and supercedes all fragmentary definitions contained in ALL New Electromagnetism documents.

Here is the V1 definition:
A fragment is a differential length of filamentary thin conductor.

The problem with the above definition rests with the fact that a “filamentary” thin conductor is designated. Many readers confuse filamentary thin (very thin*) with infinitesimally thin (infinitely thin*). In this document, the definition of a fragment is clarified in order to avoid this confusion and to introduce three dimensional modeling with NE.

Here is the V2 definition:
A fragment is a differential length of conductor with a differential cross sectional area.

The above definition is implied in section 6.3.1 of the paper New Induction (ni.pdf); however, it was never formally stated.

* From Webster’s New World Dictionary.

1 Usage Guidelines

The following techniques are demonstrated generically and thus are applicable to all fragmentary models of New Electromagnetism (V1 and V2).

1.1 Bundle of Fragments model

The most rigorous application of the Fragmentary New Electromagnetism models treats each conductor as a "bundle of fragments". The following diagram shows the bundle of Fragments method which was first detailed in section 6.3 of New Induction for intrinsic modeling.

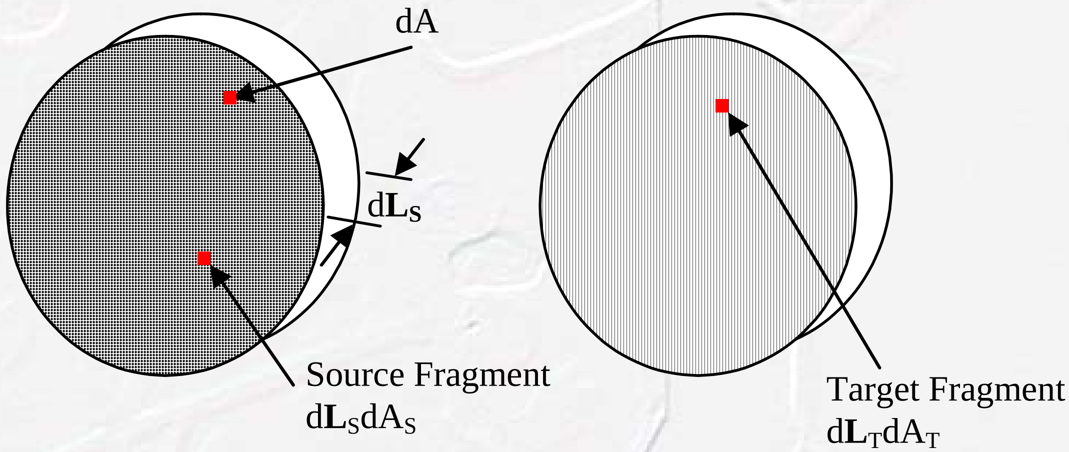


Figure 1-1: "Bundle of fragments" model of wire

In the above diagram, a differential length of the source loop is shown on the left and a differential length of the target loop is shown on the right. Each of these differential lengths is divided into very small areas (dA). Each one of these small areas of differential length is a fragment.

The current though each fragment (small area) is given by $I(Fragment) = JdA$ or in the case where a uniform current can be specified $I(Fragment) = \frac{I(total)}{A} dA$. For an example application see section 6.3.1 of the paper New Induction (ni.pdf).

To properly compute the effect of one loop on the other requires a sextuple integral (the area integrals count as two each):

$$Result = \iiiint J_S J_T (NE) dL_S dA_S dL_T dA_T$$

Where the (NE) is your favorite New Electromagnetism fragmentary model properly set up for the integration. J_S and J_T are required depending upon the NE model and application. Again, for an example application see section 6.3.1 of the paper New Induction (ni.pdf).

The above setup is absolutely required for intrinsic inductance modeling and induction heating modeling for which we are pursuing using numerical integration. Because of the sextuple integration, computer solutions require an inordinate amount of time to complete to any degree of accuracy. Because of this, we have developed new Fractal techniques which reduce integration time by 1000 fold. These techniques are pending a provisional patent application and will be embedded in most of the software released to support the books (NIA1—BK101, NM-BK001, and GEM3).

There are also other considerations that need to be addressed in the above application. These considerations include radial current movement due to non-even effects and others.

1.2 Solution Simplification

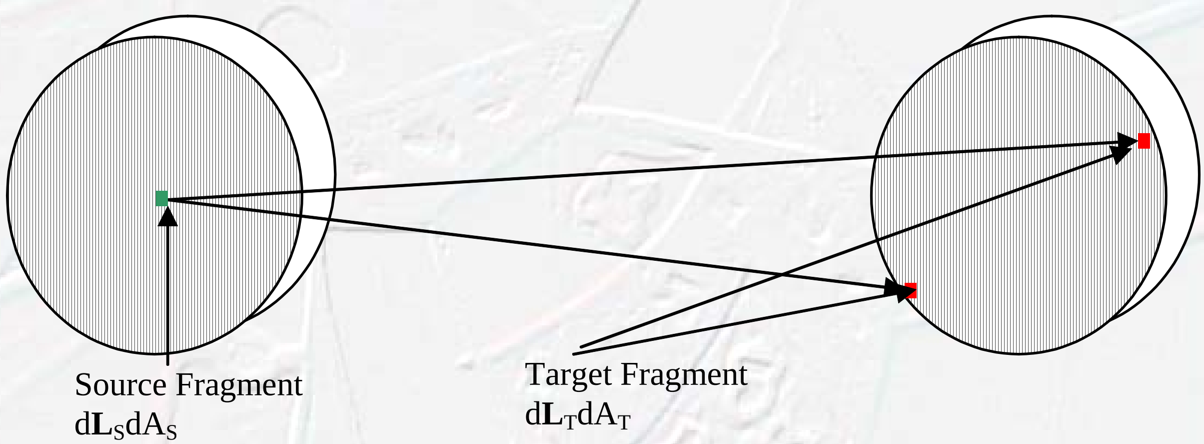
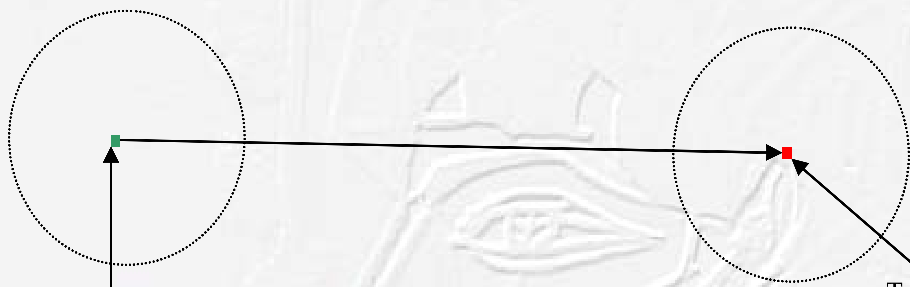


Figure 1-2: Substantially the same effect

If any given source fragment has substantially the same effect on any given target fragment in the target bundle, then the entire problem may be simplified to two filamentary fragments at the center of the wire.



Instead of having in integrate the current density over the cross sectional area as in the "bundle" method, you simply treat the problem as if the total current passes through a very small area in the center of the conductor. This is the standard application method for the fragmentary models.

The above technique has been tested to a high degree of accuracy (1%) for PCB traces as close as 20 mils and frequencies up to 20 Mhz. More extensive testing at higher frequencies and closer tolerances are slated to coincide with the initial testing phase of our software product GEM3.

The above simplification is similar to others used throughout physics. An example is the way that masses are treated as point masses for simplified use of Newton's Equation. As long as the simplification is used properly, excellent answers can be obtained.

1.3 Advanced Point-to-Fragment conversion identities

In V1 documents, the reader is treated to Point-to-Fragment conversion identities which enable the conversion between point and fragmentary models (see ne.pdf section 2.2). Since fragments may also be part of a fragment bundle where each fragment contains a portion of the total current, we then expand the Point-to-Fragment Conversion appropriately. The following is a more expanded list of identities.

$$Q\mathbf{v} = Jd\mathbf{L}dA = Id\mathbf{L} = \frac{I}{A}d\mathbf{L}dA$$

A=cross sectional area of wire normal to dL
d**L**=vector differential length of wire
J=current density at given point passing through dA
I=total current in cross section (A)
Q=point charge
v=vector velocity

Naturally the astute reader should be able to expand the list to include more forms of the identity.

2 Thank you

We would like to thank the physicists and engineers from around the world who have taken the time to read our publications and give us feedback.

Your comments and suggestions have enabled us to identify points of confusion (such as this) in order to evolve New Electromagnetism into a more rigorously stated science.

