Maxwell's equations revisited

A critique of orthodox electromagnetic theory

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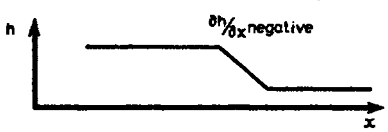
"It was once told as a good joke upon a mathematician that the poor man went mad and mistook his symbols for realities; as M for the moon and S for the sun."
Oliver Heaviside, Electromagnetic Theory, 1893, volume 1, page 133.

". . . the universe appears to have been designed by a pure mathematician."
Sir James Jeans, The Mysterious Universe, 1931, page 115.

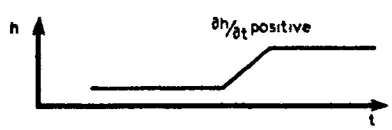
Faraday's Law of Induction, $v = -d\phi/dt$, seems to imply:
1. A causality relationship; the rate of change of magnetic flux through a surface *causes* a voltage around the circumference of the surface.
2. A reluctance, or resistance to the change of magnetic flux indicated by the minus sign.

A careful analysis of this one equation will give an insight into the bogus nature of contemporary mathematical operations in electromagnetic theory. First let us discuss the minus sign, which leads us to the idea of a Lenz's Law reluctance, or resistance, to the change $d\phi/dt$. We shall see that a minus sign can occur in an equation when no causality can be involved.

Consider a high speed (125) railway train with sloping front passing an observer. As the front face passes, the observer will see a negative slope $\partial h/\partial x$ as shown below. However, if the



observer had watched the event through a narrow slit in a fence, he would have seen a rising edge $\partial h/\partial t$, as shown here.



It would be absurd to suggest that there was a causality relationship between $\partial h/\partial x$ and $\partial h/\partial t$. They are both descriptions associated with the passage of the train. Since Newton, it is accepted that a *body* continues in its state of uniform motion without a continuing cause, or push. (However, this principle is taking a long time to be applied to electromagnetic waves.)[1,2]

Now we regard the velocity of the train $\partial x/\partial t$ as positive. This creates an anomaly when we want to write the equation

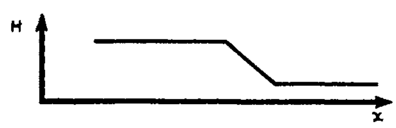
$$\frac{\partial h}{\partial x}\cdot\frac{dx}{dt}=\frac{\partial h}{\partial t} \qquad (1)$$

because the left hand side product is negative when the right hand side is positive, as in the case of the leading face of the train.

This kind of absurdity, or anomaly, is ignored when Newton's Laws are considered. It is reasonable to do so, because Newton's Laws are close to common sense and the obvious. Common sense will prevent absurd conclusions from creeping into a Newtonian theoretical framework, even though the mathematical formulation of Newton's Laws has always been slovenly in this respect.* (Another perhaps permissible slovenly aspect is the use of the = sign for numerous different, mutually contradictory meanings.)

Maxwell's Equations are not in the same class. Common sense will not save us from absurdity and nonsense if our initial formulations are ambiguous or wrong.

Let us consider an electromagnetic wave front advancing at the speed of light. When the step (or more accurately ramp) passes, as shown here



$\partial H/\partial x$ is negative. However, $\partial H/\partial t$ for the step is positive. To get the algebra right, we are forced to conclude that

$$\frac{\partial H}{\partial x}\cdot\frac{dx}{dt}=-\frac{\partial H}{\partial t} \qquad (2)$$

However, no one would propose that the minus sign indicated a *causality* relationship between $\partial H/\partial x$ and $\partial H/\partial t$.

The last equation never appears in the text books. In the books, one of the terms is first converted into a function of E according to the formula

$$\frac{E}{H}=\sqrt{\frac{\mu}{\epsilon}}$$

The result is either

$$\frac{\partial E}{\partial x}=-\frac{\partial B}{\partial t} \qquad (3)$$

or

$$\frac{\partial H}{\partial x}=-\frac{\partial D}{\partial t} \qquad (4)$$

The text books say the "solution" to this pair of equations is a sine wave! See references 3 to 7. (In fact, almost anything is a solution to these equations.)

At this stage, the whole subject starts to look sophisticated and profound. Really it is neither. The minus signs have no significance, as we have seen. B and D are introduced on the r.h.s merely to suppress μ and ϵ using the formula

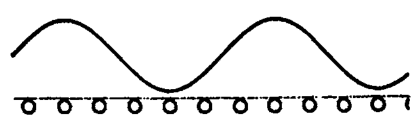
$$\frac{E}{H}=\sqrt{\frac{\mu}{\epsilon}}$$

In fact, the last two equations (3), (4) are meaningless. If the front end of the high speed train were pointed, sloping out sideways as well as upwards, and w were the term given to width (as H stands for height), exactly the same pair of equations could be constructed.

$$\frac{\partial w}{\partial x}=-\mu\frac{\partial H}{\partial t}$$

$$\frac{\partial H}{\partial x}=-\epsilon\frac{\partial w}{\partial t}$$

As with e-m theory, we could conclude with equal validity that a train's height (and width) must vary sinusoidally along its length, making our trains look like the Loch Ness monster, or more accurately, like a row of short sausages, as shown here.



It is shocking that this nonsense has survived for a century at the core of a subject as crucial as electromagnetic theory. We see now that mathematical formulation of e-m theory, far from making the subject more rigorous, has

* Even the brilliant philosopher Ernst Mach failed to notice this anomaly.

made it ludicrous and false. We see that the mathematicians are incompetent where physical reality is concerned and hide their incompetence and confuse others by conjuring up nonsensical, interrelated formulae.

When Hertz established that electromagnetic waves existed, Maxwell's equations should have been re-examined, and the large rubbish element removed. Instead physically ignorant mathematicians took over, piling garbage on garbage, frightening away those with real insight into the subject – the latter-day Faradays.

Those who try to build extensions, or additions to, the House of Newton should not assume that since the foundations were good enough for Newton's simpler theory, they are strong enough to support their own more complex constuctions. Minkowski's failure to re-examine the foundations of Newton, in particular his assumption that velocity is positive and the passage of time is positive, makes his constructions useless in the same way as Maxwell's equations are useless.

In the Minkowski sense[8] time really flows from $+\infty$ to $-\infty$, not, as he thought (and our clock faces, with their ascending sequence of numbers, think), from $-\infty$ to $+\infty$. Velocity, being the gaining of distance in return for the *loss* of time, is negative. This points to a fundamental difference between space and time, and means that the "space-time continuum" as Minkowski formulated it is bogus. At best, we see his pronouncements as oracular, similar to the answer that Delphos gave when being asked about the sex of an unborn child, "Girlnoboy". This remark could well be interpreted as true, but really it has no content.

Einstein failed to consider the problem of the sign of time and of velocity. Also[9], he never succeeded in fighting his way through the mass of mathematical garbage surrounding electromagnetic theory.

References

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Impedance mismatching

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Thus, for maximum power transfer efficiency from the Norton source, the load must be such that $R_L/R_s \to 0$ (the opposite of the voltage source case). A similar set of arguments to those used above can be used to show that the expression for η is meaningless unless the actual circuit is a simple current source with source impedance.

Despite the fact that Thevenin/Norton equivalent sources do not allow calculation directly of the transfer efficiency, it is perfectly true that to attain maximum power transfer into a load, the load impedance should be chosen to match the Thevenin or Norton source impedance (they are the same) but to say that this means 50% of the power from the source is lost in the source resistance is in general not true; often the power loss in the source resistance is higher!

Despite the cautions outlined in this paper the notion of transfer efficiency is not without its uses, since a number of frequently encountered circuits behave as true Thevenin or Norton circuits; for example, the common emitter amplifier shown in Fig. 5. Neglecting the bias-resistance loading effects and assuming that all capacitors are short circuits, the mid-band voltage gain is given approximately by

$$A_v = \frac{v_0}{v_i} \left(\frac{-R_{c2}}{r_{e2}}\right) \cdot \left(\frac{-R_{c1}\beta_2 r_{e2}}{R_{c1}+\beta_2 r_{e2}}\right) \cdot \left(\frac{1}{r_{e1}}\right)$$

$$A_v = \left(\frac{R_{c2}}{r_{e1}}\right) \left(\frac{\beta_2}{1+\frac{\beta_2 r_{e2}}{R_{c1}}}\right)$$

$$A_{vmax} \sim \left(\frac{R_{c2}}{r_{e1}} \cdot \beta_2\right),$$

which occurs when the input impedance of Tr_2 is much less than the collector resistance of Tr_1, i.e. $\beta_2 r_{e2} \ll R_{c1}$. The output of Tr_1 is a current source of impedance R_{c1} and the Norton transfer efficiency result obtained above tells us that $R_L/R \to 0$ for good transfer efficiency, i.e. $\beta_2 r_{e2}/R_{c1} \ll 1$.

In conclusion, I would stress that extreme care should be taken to interpret the components of a Thevenin or Norton equivalent circuit correctly especially in deriving expressions for losses in power transfer. □

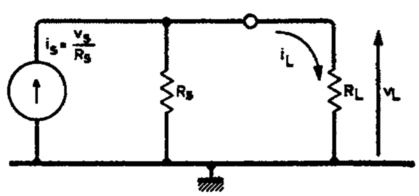

Fig. 4. Current equivalent to Fig. 1.

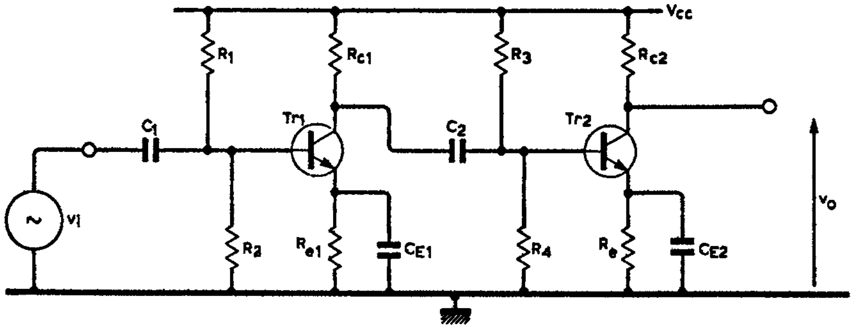

Fig. 5. Amplifier inter-stage coupling behaves as current source, as in Fig. 4.