# The Rolling Wave

My article at http://www.ivorcatt.co.uk/x267.pdf discusses the two versions of the TEM Wave. Today, in September 2012, I have modified my view, and I now think that 95% of professors and text book writers adhere to "The Rolling Wave", as do Einstein and Feynman. http://www.ivorcatt.co.uk/x0102em.htm Below is half of Professor A F Kip's (University of California, Berkeley) development of The Rolling Wave in his book "Electricity and Magnetism", 1962, p320.

Ivor Catt, September 2012.



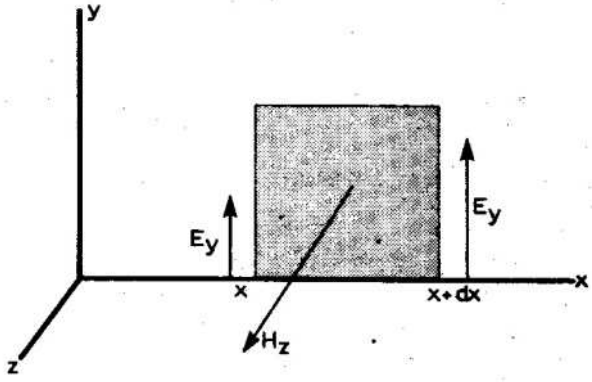
## Appendix 2: the rolling wave explained

In this article, two mutually contradictory versions of the transverse electromagnetic wave have been described and compared. These were the rolling wave and the Heaviside signal. This appendix contains the first half of a very clear description of the rolling wave taken from "Fundamentals of Electricity and Magnetism" by Arthur F. Kip, Professor of Physics, University of California, Berkeley, published by McGraw-Hill, 1962, page 320. Only enough of that description is reproduced to make his approach clear.

"... Our demonstration involves the use of the first two Maxwell equations to show that such a postulated time and space variation of $E$ gives rise to a similar time and space variation of $H$ (but at right angles to $E$) and that this $H$ variation acts back to cause the postulated variation in $E$. Thus, once such a wave is initiated, it is self-propagating.

"The figure below is used to show the application [of Faraday's law of induction] to the plane $E$ wave, postulated to be moving along the $x$ direction. A convenient closed path is drawn in the $xy$ plane, around which we shall take the line integral of $E$. This is equated through [Faraday's law] to the rate of change of flux $H$ through the plane bounded by the path of the line integral. Only the vertical parts of the line integral contribute since $E$ is in the $y$ direction, so that $E.\partial x = 0$. If we go around in a counterclockwise direction, the line integral around the path chosen becomes

$$\oint E \cdot dl = (E_y)_{x+dx}dy - (E_y)_x dy$$
$$= [(E_y)_{x+dx} - (E_y)_x]dy$$




where we are to take the values of $E_y$ at $x+dx$ and $x$, respectively. The difference between these two values of $E_y$ at the two positions is $(\partial E_y/\partial x)dx$, so we can write the line integral of Faraday's law of induction as

$$\frac{\partial E_y}{\partial x} dxdy = -\mu_o \frac{\partial H_z}{\partial t} dxdy$$

Since this relationship is true for any area $dxdy$, we may write

$$\frac{\partial E_y}{\partial x} = -\mu_o \frac{\partial H_z}{\partial t}$$

(This ends the extract from Kip. To get to the Carter equation we have to replace $\mu H$ by $B$, of course.)

*This article is taken from "Electromagnetic Theory", published by C.A.M. Publishing, 17 King Harry Lane, St Albans, Herts. The next seminar by CAM Consultants on digital electronics design will be held at St Albans on August 2-3.*

Since $B=\mu H$, it would be more elegant to write $\delta E/\delta x = -\delta B/\delta t$ .

If a tapering piece of wood, tapering in the vertical and also the horizontal direction into a forward point, travels forward at velocity dx/dt, then $\delta h/\delta x = -\delta w/\delta t$. Even worse, if h is its height, $\delta h/\delta x = -\delta h/\delta t$ . Thus, "h gives rise to h", in the words of Kip.

# January 2013. The plot thickens.

Faraday's discovery of electromagnetic induction was not that, in mathematical terms, $\delta E/\delta x = -\delta B/\delta t$

Rather, if he discovered electromagnetic induction, it would have the formula $E = -\delta B/\delta t$. Why did I not add this last September? – Ivor Catt

Kip writes (above); the "two Maxwell Equations .... show that such a postulated time and space variation of E gives rise to a similar time and space variation of H .... and that this H variation acts back to cause the postulated variation in E." Kip believes the equations validate the Rolling Wave. But I have pointed out that they "state" "The Heaviside Signal".

> We should conclude that if the two equations are compatible with either of the conflicting versions of the TEM Wave, "The Rolling Wave" and "The Heaviside Signal," http://www.ivorcatt.co.uk/2604.htm , they are so bland that they tell us nothing at all. The ambiguity of mathematical formulae, of which this is merely an example, tells us that "mathematics is **not** the language of science". Introducing the word "**not**" reduces the Google hits from 100,000 to 3.
>
> Ivor Catt 28 Nov. 2014

Note that Kip says; $dB/dx = - dB/dt$. This was the way electromagnetic theory was discussed in the 1950s. The situation today is much worse. Both of my colleagues Dr. David Walton and Forrest Bishop say that the present style, using divs and curls, see Maxwell , is even further from physical reality.

It is frustrating that insights come to me only after many decades. An important one has only now come to me. I did engineering, not electrical engineering, at college, so I had a little "fluid mechanics". I can well accept that div and curl could be useful in fluid mechanics, but should not have been transferred across without thought to electromagnetic theory. The major difference is that in the latter but not the former, things travel at the speed of light, making em theory totally different.

Ivor Catt 5 December 2014