Light waves and Special Relativity, by Roger J. Anderton

R.J.Anderton@btinternet.com

The illusionary nature of waves as explained in elementary physics texts has not been properly appreciated when dealing within the context of special relativity. Hence various mistakes have been made in dealing with relativity theory. This article will consider some of those mistakes.

Considering waves from an elementary level as presented at "The School for Champions" an educational website, Ron Kurtus [1] explains:

"A wave is a distortion in a material or medium, where the individual parts of the material only show periodic motion, but the waveform itself moves through the material. All waves have similar characteristics, and since all forms of wave motion follow the same laws and principles, knowing the fundamentals of wave motion is important in understanding sound, light, and other types of waves."

He then defines wave motion:

"Wave motion is defined as the movement of a distortion of a material or medium, where the individual parts or elements of the material only move back-and-forth, up-and-down, or in a cyclical pattern. It appears as if something is actually moving along the material, but in reality it is just the distortion moving, where one part influences the next."

The "something that is actually moving" – is the wave. And in the case of light wave carries energy and by Einstein's E=mc/\2 energy has effective mass, and this energy/mass is quantized as a quanta of light called photon.

Kurtus gives special note to light waves:

“Although light is classified as a transverse wave, the motion of the electrical and magnetic fields may be circular instead. It is hard to tell.”

Light waves are represented as transverse waves, being distortions in the electrical and magnetic fields. As pointed out in a previous article, [2] there is actually more than just these two fields, giving a unified field (as the sum of these three fields: magnetic, electrical and the extra field); the extra field gives the longitudinal part of the distortion; hence unified wave is longitudinal and transverse distortions. I.e. Kurtus’s “…maybe circular. It is hard to tell.” is the unified field wave model of light which is a more complete description of light than just the electromagnetic wave (which considers only the disturbance in the electrical and magnetic fields).

The medium of the light wave is sometimes called aether; and explained in a previous article [3] this medium exists contrary to some peoples’ expectations. In the case of the electromagnetic wave model of light wave this aether is then the electromagnetic field. In the case of the unified wave model of light, the aether is the unified field. (i.e. there is a electromagnetic aether and a unified aether)

This unified field medium appears to move in a cyclical pattern, it creates a wave that appears to move across that medium. (Same as water wave on surface of a still pond, has the molecules of the water medium moving in a cyclical pattern.)

What seems to be overlooked when progressing from the elementary level of waves to special relativity is that -- this wave motion of the light wave is an illusion. Despite there being a special class of observers in special relativity (under the certain conditions of them being inertial and so forth*) who observe lightspeed as always c for this disturbance in the light medium; this motion is illusionary.

*- the so forth is that we are dealing in the theory with a mathematical idealisation of lightspeed travelling in a vacuum without interacting with particles of matter and fields, so that it can appear as a constant for inertial observers.

So, we have these several errors in certain physics texts which I will summarise:

Light wave modelled by electromagnetic wave is an incomplete description; it considers only the electrical and magnetic fields and so represents the light wave as only transverse.

(Light wave is better modelled as unified wave, and has the light wave with both transverse (electromagnetic) fields and longitudinal field.)

The medium of light wave exists if one defines it correctly (see relevant article [3]).

The medium of the light wave moves in cyclical motion; while the wave motion across it is illusionary the same as any wave in a medium (e.g. water wave).

So, we proceed from this:

Noting once again -- although special relativity observers observe the same lightspeed namely c; what “they” are observing is illusionary.

It is odd that this has not been pointed out before.

The consequences of this are:

Both special relativity and Galilean relativity work.

This is contrary to many peoples' expectations. (Usually, if they believe the mainstream then they think that special relativity has replaced Galilean relativity. And their error is not recognising lightspeed c is an illusion; a fact from elementary physics that they have overlooked.*)

*- It is also the general case that mistakes have been made by many people as they progress from elementary physics to more advanced physics. Presumably most people have a problem with understanding even elementary physics, and so when they progress to higher levels of physics they add their elementary physics mistakes to their attempt to understand higher physics. If they had for instance understood the nature of elementary physics with regards to waves, giving us the illusionary nature of wavespeed then they would not have added their mistake to their attempt to understand Einstein's relativity, and not then incorrectly inferred that special relativity replaces Galilean relativity. Other examples of mistakes – are they could not understand that the maths of wave waves is the same maths as special relativity when it deals with the Michelson-Morley experiment; if they had not made their incorrect inferences then they would not be stating their numerous mistakes on that subject in various physics texts.

Special relativity as constructed by Einstein deals only with the electromagnetic wave model of light not the unified wave model; so let us think of things in those terms of electromagnetic wave model for a moment.

When we have two observers claiming the same lightspeed for the lightwaves they are observing, but the two observers move at different speeds; let us call observer A and observer B.

We might be tempted to define the maths for such a scenario as follows:

A measures light travelling distance L_A in time interval T_A

B measures light travelling distance L_B in time interval T_B.

And since both measure the same lightspeed c, we have:

L_A/T_A = L_B/T_B = c (1)

Suitable math manipulation and we can form things called Lorentz transformations and so forth and then form the maths of special relativity (n.b. not progressing in this article to deal with special relativity applied to things other than length, time, speed.*)

*- A point that I will pick up on later.

Various physics texts do talk about special relativity in this manner, unfortunately it does have quite a few ambiguities by talking about things that way; so I will expand the maths as follows:

Let us define T_{AA}, T_{AB}, L_{AA}, L_{AB} as observed from the A frame:

T_{AA} = time interval measured from A frame of itself

T_{AB} = time interval measured from A frame for B

L_{AA} = length measured in A frame of itself

L_{AB} = length measured in A frame for B

And similarly for B frame:

T_{BA} = time interval measured from B frame for A

T_{BB} = time interval measured from B frame for itself

L_{BA} = length measured in B frame for A

L_{BB} = length measured in B frame for itself.

We thus have 8 parameters now instead of 4. In the 4 parameter model, such quantities as T_A and L_A were ambiguous, because although we defined them as: "A measures light travelling distance L_A in time interval T_A" we had not said who believes this, i.e. does A believe s/he measures L_A and T_A or does B believe that A measures L_A and T_A. The 8 parameter model more clearly defines who believes what. The 4 parameter model can work, but because of being unclear on who believes what, mistakes can easily occur; and if one reads the various relativity texts then these mistakes can be seen to occur quite repeatedly.

Recognising this inherent ambiguity in the 4 parameter model, I will revert back to using it for this article for the sake of trying to keep things simple for the time being, and hoping the reader is intelligent enough not to make the mistakes in understanding that the 4 parameter model's ambiguity can lead to.

The relevant equation was:

$L_A/T_A = L_B/T_B = c$ (1)

However, instead of equation (1) there is another option. Recognising the illusionary nature of lightspeed, instead of assuming (1), we might assume that each observer measures the same time intervals, so that:

$T_{Anew} = T_{Bnew} = T_{new}$

n.b. these are different time intervals to that in (1).

So, that we now have:

$L_A/T_{new} = c_A$

And

$L_B/T_{new} = c_B$

We then have Galilean relativity with its variable lightspeed.

It might be protested that when A and B comes to rest with respect to each other, that they can then compare their lightspeed measurements, and observe them unchanged.

The major problem with this is that special relativity and Galilean relativity are dealing here in this article with inertial conditions, and to actually bring A And B at rest with respect to each other then some non-inertial effect has to take place.

So, really such a protest should be restricting itself thus: when A and B come to rest with respect to each other, and when they compare their lightspeed measurements they can note that they have not varied when they were in inertial conditions (and other special relativity conditions). But the same is true of the time measurements.

There is a type of relativity between the two relativity theories. Neither theory predicts things that can be observed in only it and not the other theory. When the observers are in motion, they either assume lightspeed the same for both of them, or they assume time intervals the same for each other, and when they come to rest with respect to each other then neither theory (when dealing with just the inertial et al.) predicts an observation exclusive to itself.

The main difficulty to consider is the non-inertial.

Under inertial conditions both Galilean and special relativity work.

However, it is hard to restrict one-self solely to inertial conditions.

Non-inertial conditions arise such as by acceleration.

Consider now an observer who moves from A frame to B frame (where B frame is at a different velocity to A frame in the general case; but let us restrict ourselves in this article to just the case where B frame is at a different speed to A frame).

In special relativity, such an observer has:

$L_A/T_A = c$ when in A frame and $L_B/T_B = c$ when in B frame.

So, for such an observer, special relativity says this observer measures c in the A frame and c in the B frame. It might then be thought that such an observer detects no change in lightspeed.

However, the observer is undergoing some non-inertial effect when moving from A frame to B frame; because s/he is changing their speed. (Change of speed is acceleration in this case; in the general case acceleration is change in velocity).

If this observer were then to take say: time interval T_A from A frame and combine it with distance L_B from B frame, then this speed L_B/T_A is not in general going to be c.

General relativity which is formed from special relativity from stepping up to consider change in speed (or velocity), takes two versions (i) has lightspeed as variable or (ii) confines itself to only special observer observations (i.e. does not mix measurements from different inertial frames such as in the L_B/T_A case, and deals with changes in space-time geometry and so forth.

Now picking up on my earlier comment of: "not progressing in this article to deal with special relativity applied to things other than length, time, speed." -- By this I mean in this article I was dealing with kinematic special relativity. The word "kinematics" means – the study of the motion of body without reference to mass or force. So, the "kinematic special relativity" I have been dealing with in this article deals only with special relativity in the context of no mass and no force; i.e. in that idealised scenario. And within the context of that "kinematic special relativity" I have pointed out a great deal of mistakes in many peoples' understanding of relativity. If we now introduce mass and force into the special relativity scenario, we are of course going to introduce a great deal more misunderstandings that people have with relativity.

My position is that relativity is correct, but a great number of people have made erroneous statements from what they believe is relativity.

The usual way we should think is from state a proposition (propositions) and then deduce the consequences. In the case of relativity, we have its propositions and that is the "theory", but when it comes to deducing the consequences of that, the majority of people just then progress into error; they make false statements which they credit to the "theory", which the "theory" does not really support. i.e. the "theory" has been misunderstood. And I have tried to highlight some of the errors that people have made with trying to understand the "theory of relativity" in this article within the context of kinematic special relativity.

The next step would be to consider acting "mass" to "kinematic special relativity" to creating what might be called "dynamic special relativity."

The word "dynamics" is the branch of mechanics concerned with the forces that change or produce the motion of bodies, and "dynamic" means physics relating to energy or forces that produce motion. So, "dynamic special relativity" would be relativity dealing with forces.

The first protest that a person well versed in relativity might make is that special relativity does not deal with forces. This of course would be by a person making a fundamentally big mistake in understanding relativity.

I accept Newtonian physics and the first steps with special relativity by Einstein are in dealing with kinematic part of Newtonian physics, i.e. dealing with constant velocity of observers (which means inertial observers). When we introduce mass to our idealised model we are introducing force according to Newtonian physics, because by Newton we have:

Force = mass * acceleration ($F = m * a$)

And the motion equation:

$V = u + a*t$ (2)

Considering the case when $u = 0$, and combine these two equations and we have:

V = (F/m) * t

i.e. an equation relating velocity v, force F, mass m and time t.

This equation shows that when we introduce mass to special relativity, we have associated with it force F.

And if we have force F then by F= m*a, we have acceleration also.

Standard texts on special relativity introduce mass (relativistic mass etc.) to Lorentz equations scenario of kinematic special relativity, and try to pretend that they are still working within the context of no acceleration; they usually state the error that they are working solely within the context of constant velocity. But that is an error that they do not see, or try to ignore; because as soon as they introduce mass, they introduce force and acceleration into the discussion. The "kinematic special relativity" scenario is when a =0, so that (2) is:

V = u

By introducing mass they no longer have v = u, and so this is a fundamental error that they then build upon in the rest of their derivations.

Dealing with "dynamic special relativity" is of course beyond the remit of this short article, but has been dealt with in my book "The Relationship between light and gravity." [4] And of course after dealing with the maths of such a theory, my historical researches show that such a theory was dealt with by Boscovich, if we allow "dynamic relativity" to be both "dynamic special relativity" and "dynamic Galilean relativity", then such a thing as this was dealt with by Boscovich's unified field theory.

Reference:

[1] General Wave Motion, by Ron Kurtus (revised 24 June 2006) at: http://www.school-for-champions.com/science/waves.htm

[2] Maxwell-Tombe's Unified Force equation http://www.wbabin.net/science/anderton7.pdf

[3] A Re-examination of the concept of Ether in Einstein's Special Theory of Relativity http://www.wbabin.net/science/anderton2.pdf

[4] The Relationship between light and gravity vol.1, RJAnderton