From: Alex Yakovlev
Sent: Saturday, May 5, 2018 5:15 PM
To: Ivor Catt
Cc: Anthony Davies; gian-luca oppo; Christopher Spargo
Subject: Re: easy

Dear All

I tried to interpret Wakefield in terms of my understanding of:

(i) the conventional transmission line theory, and

(ii) Catt theory.

Attached is a graphical illustration of the spatio-temporal process.

We have a TL, which is tapped in three points, A, B and C.
Point A is close to the battery, where we disconnect the TL from the battery. Point B is half-way away. Point C is the end of the TL, where the shortening takes place.

Event 2 is when the LHS switch is OFF and the RHS switch is ON.

The waveforms show the signals in points A, B and C.

Here is the difference between the theories:

(i) The conventional theory pays attention to the steps and their magnitudes in terms of the change of potential. These steps from events. The magnitude of each step is 8V. Because the TL is loss-less, these steps never attenuate.
These steps propagate the length of TL and get reflected either at point A (open) or point C (short).
According to the conventional theory, when a step is reflected at open, the additional change is calculated with coefficient (+1), hence we have the cumulative changes of magnitude (-8)+(-8)=(-16) and (+8)+(+8)=(+16) - see the waveform at point A, and when a step is reflected at short, the additional change is with coefficient (-1), hence we have the cumulative changes to be (-8)+(+8)=0 and (+8)+(-8)=0 - see the waveform at point C.
At point B we only have 8V steps in transit.

(ii) The Catt theory pays attention to the permanent energy current everywhere. It's useful to associate energy current with some kind of wind flow, which is always there. The wind flows in both directions. What changes with events in the system is the magnitude of the wind, either in one direction of both. Catt's theory, according to my understanding, therefore pays attention to the current LEVELs of the wind. These levels are shown as pairs, such as for example, (<- -4, -> +4), which means that in this particular interval of time in, say point B, the energy wind is blowing from the RHS to the LHS at level (-4) whilst the energy wind blowing from the LHS t to the RHS at level (+4).

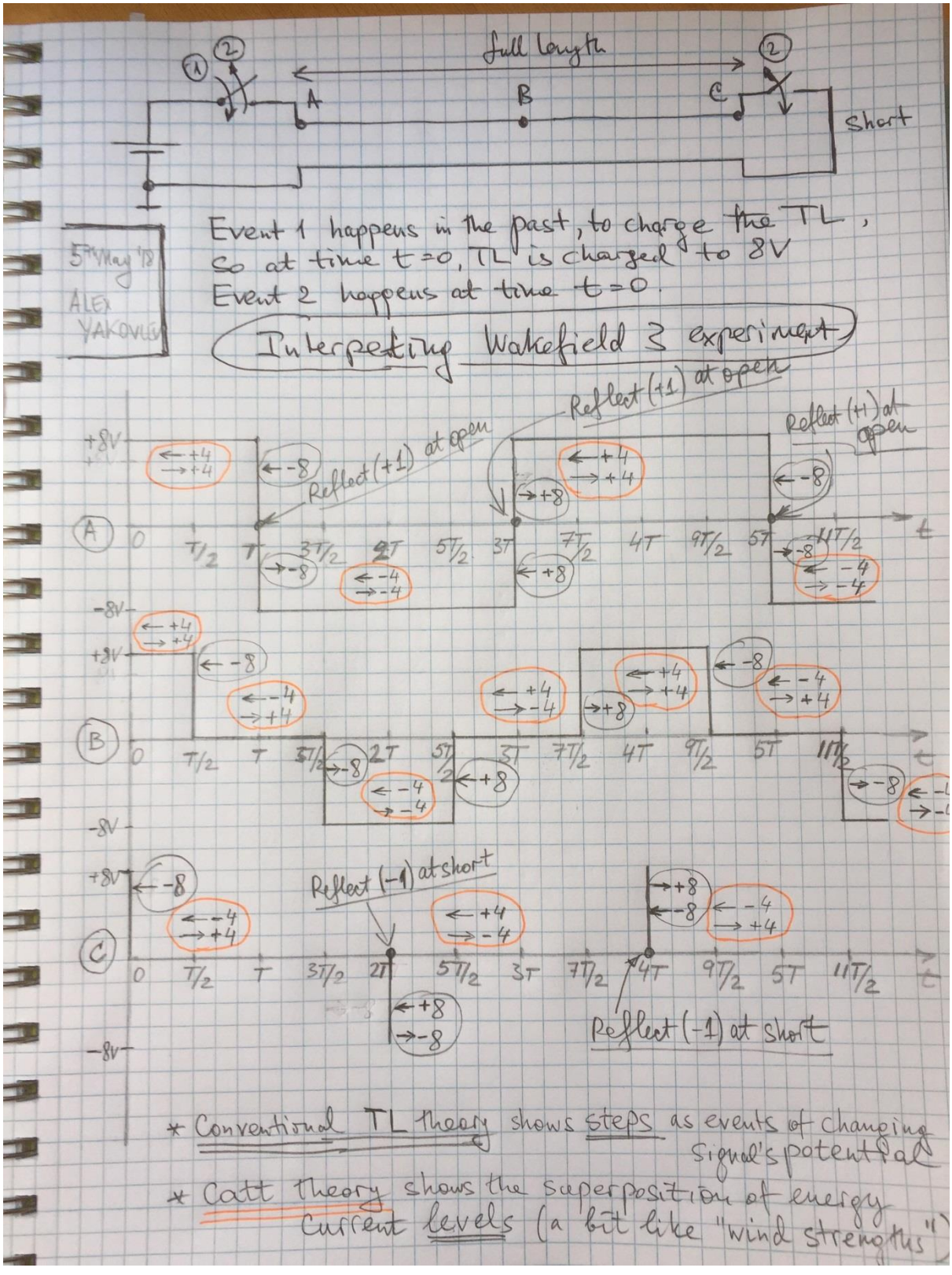
It is however important to mark the events associated with the changes of the level of the wind. These events happen exactly at the same moments when steps happen in the conventional theory - how can it be different! - in both cases the speed of event propagation is the velocity of light.
So, for example, at point B, we can have a transition from the state (<- -4,->+4) to state (<- -4,->-4), when the wind from the LHS changes its strength from +4 to -4. This happens due to the prior reflection at the Point A open (which causes a step of -8 to propagate).

So, this is my interpretation of what's going on in this experiment. Because we have clearly defined events and levels of signals, I can in principle model this process with Petri nets, in which transitions and places can be associated with the tapping points. The intervals during which the signal (wind) stays at a particular level (strength) can be captured in the notion of token marking.

I hope Tony still remembers my passion to use Petri nets to model all kinds of processes. In this example, we have very nice spatio-temporal events and cause-effect relationships, so Petri nets would be most appropriate!

I hope that my interpretation will give some meaning to you, and I tried to avoid any mathematics. Everything is described in graphics and text around it.

Kind regards
Alex


full length
1
2
A
B
C
2
Short
5th May '18
ALEX YAKOVLEV
Event 1 happens in the past, to charge the TL,
so at time t=0, TL is charged to 8V
Event 2 happens at time t=0.
Interpreting Wakefield 3 experiment
Reflect (+1) at open
Reflect (+1) at open
Reflect (+1) at open
+8V
-8V
A
B
C
t
0
T/2
T
3T/2
2T
5T/2
3T
7T/2
4T
9T/2
5T
11T/2
Reflect (-1) at short
Reflect (-1) at short
* Conventional TL theory shows steps as events of changing signal's potential
* Catt theory shows the superposition of energy current levels (a bit like "wind strengths")

From: Alex Yakovlev
Sent: Sunday, May 6, 2018 9:51 AM
To: Ivor Catt
Cc: Anthony Davies; gian-luca oppo; Christopher Spargo
Subject: Re: easy

Dear All,

I have now produced a graphical interpretation of Wakefield 3 experiment in terms of "Catt's travelling pulses". The picture is attached.

It's better to see this picture together with the one I sent yesterday.

According to my understanding of the Catt theory, in every point of the TL we always have a superposition of two energy current levels, called "travelling pulses" by Ivor. One is travelling left and the other is travelling right. The length of such pulses is always 2T (twice the length of the TL). The height of the pulse is always 4V. When a pulse faces LHS (open circuit) it is reflected with coefficient +1 (basically duplicated), when a pulse faces RHS (short circuit) it is reflected with coefficient -1 (basically inverted).

My understanding of the Catt theory in relation to its explanation of the waveforms of signals in TL is that Catt theory takes such travelling pulses as a basis of elementary blocks and each waveform is a superposition of these blocks. According to Catt theory this is the most natural (Occam's Razor principle) way of seeing the world of pulse-switching behaviour, as the only postulate we have is that in every point in space we have energy current travelling with light velocity. Pulses are shaped in duration by length in geometry of the medium and conducting plates, and in amplitude they are determined by batteries and the state of terminal points (opens, shorts).

Conventional TL theory, in order to explain these behaviours, requires to introduce telegraph equations, with concepts of voltage and current etc, and according to Ivor is more convoluted and divorced from reality.

I could also extrapolate my understanding of the ramifications of Catt theory with regards to explaining electromagnetic circuits. Catt theory proposes to use travelling pulses as a basis for representing complex waveforms. In linear systems, people widely used harmonics as such basis.

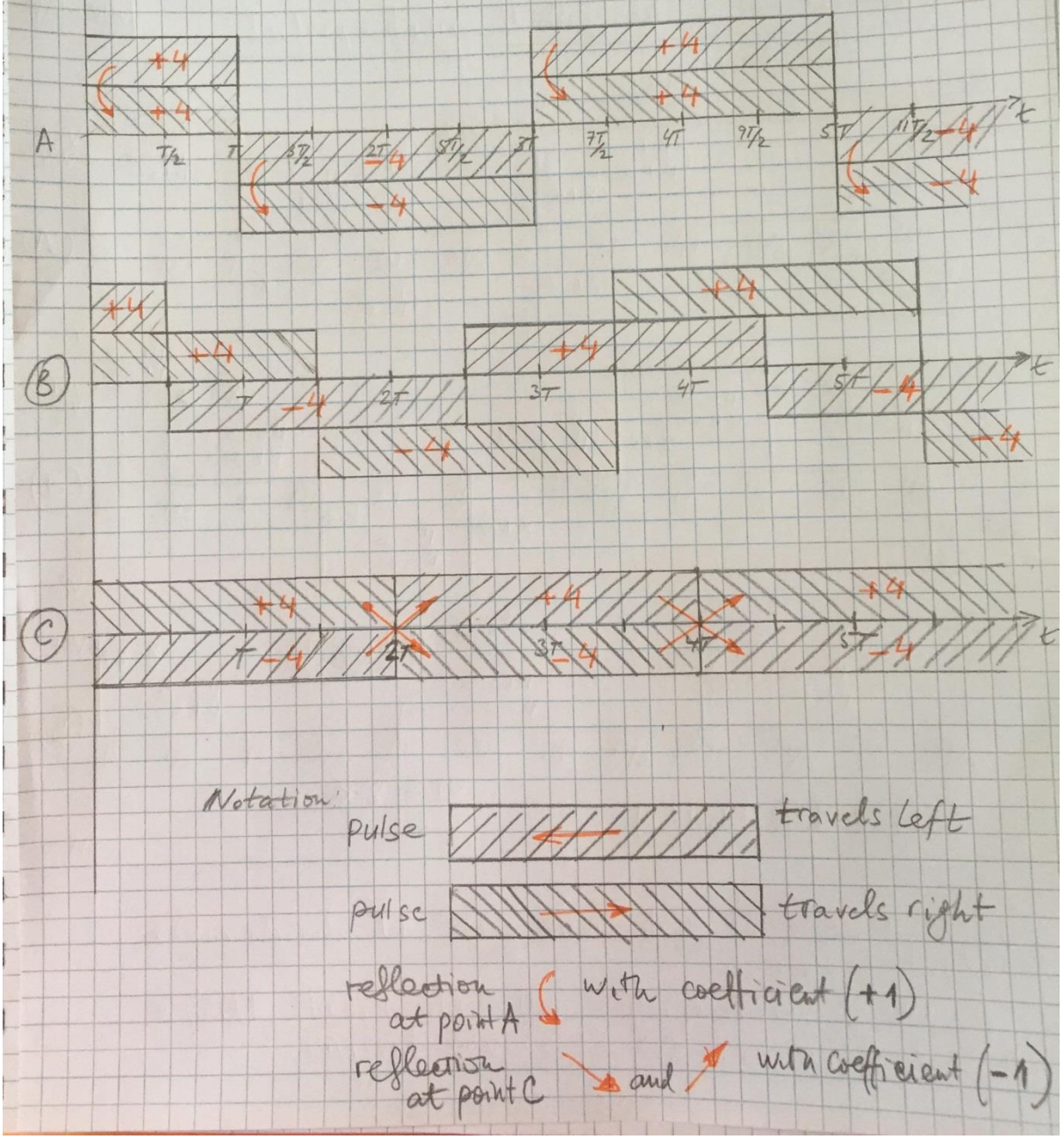
Catt theory's pulses are linked to events, and events have cause-effect relationships in the points in space where signals are reflected. This works most effectively in time-domain.

Harmonic analysis, to the contrary, is not based on events and causality, it is based on the standing waves and hence operates most efficiently in frequency domain.

Kind regards,
Alex

6th May '18
ALEX YAKOVLEV

Interpreting Wakefield 3 experiment (ctd) in terms of Catt's travelling pulses



Notation:

pulse ← travels left

pulse → travels right

reflection at point A ↷ with coefficient (+1)

reflection at point C ↘ and ↗ with coefficient (-1)