PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A

MATHEMATICAL, PHYSICAL AND ENGINEERING SCIENCES

Energy current and computing

Alex Yakovlev
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Abstract

In his seminal *Electrical papers*, Oliver Heaviside stated ‘We reverse this …' http://www.ivorcatt.co.uk/x3117.htm referring to the relationship between energy current and state changes in electrical networks. We explore implications of Heaviside's view upon the state changes in electronic circuits, effectively constituting computational processes. Our vision about energy-modulated computing that can be applicable for electronic systems with energy harvesting is introduced. Examples of analysis of computational circuits as loads on power sources are presented. We also draw inspiration from Heaviside's way of using and advancing mathematical methods from the needs of natural physical phenomena. A vivid example of Heavisidian approach to the use of mathematics is in employing series where they emerge out of the spatio-temporal view upon energy flows. Using *series* expressions, and types of natural discretization in space and time, we explain the processes of discharging a capacitive transmission line, first, through a constant resistor and, second, through a voltage controlled digital circuit. We show that event-based models, such as Petri nets with an explicit notion of causality inherent in them, can be instrumental in creating bridges between electromagnetics and computing.

This article is part of the theme issue ‘Celebrating 125 years of Oliver Heaviside's ‘Electromagnetic Theory’’.

1. Preface

This year

…. ….

Yet, in the year 2013, I came across Oliver Heaviside's work in full. ….
Next, in the same 2013, by sheer coincidence I exchanged emails with Mr Ivor Catt about the late Professor David Kinniment, my colleague and mentor of many years, who studied an interesting and challenging phenomenon called metastability (connected to the philosophical problem of choice and the story of Buridan's ass) [4,5] in digital circuits during his 45-year academic career. From David Kinniment http://www.ivorcatt.co.uk/x8bkinn.pdf I had known that **Ivor Catt was one of the early discoverers of this phenomenon, which he called The Glitch** [6]. **http://www.ivorcatt.co.uk/x84gglitch.pdf ; http://www.ivorcatt.co.uk/x1bn.pdf ; http://www.ivorcatt.co.uk/x5a6.htm .** To my amazement, in my conversation with Ivor Catt, he told me about his other passion. That other work, which had absorbed him for nearly 40 years, was on developing and promoting his own version of electromagnetic theory (called Catt-theory or **Theory C**) [7] [Note 1]. Ivor Catt sent me his book and several articles in IEEE journals and in the *Wireless World* magazine. **They showed how this theory advanced Heaviside's theory** (Theory H) of transverse electromagnetic (TEM) waves and the concept of **energy current**. I managed to organize a seminar on Electromagnetism at Newcastle on 9 October 2013 to which I invited Mr Ivor Catt and Dr David Walton, who worked with Ivor Catt on various parts of his theory, particularly on demonstrating that **a capacitor is a transmission line** (TL) [8] http://www.ivorcatt.co.uk/x3b2.pdf . Coincidentally, David Walton obtained both of his Physics degrees from Newcastle University, and on the same day of 9 October 2013 there was a historical 50th anniversary reunion of Electrical Engineering graduates of 1963, some of whom had known David Walton (moreover some again, by coincidence had known Ivor Catt), so **the date was truly momentous**. Ivor Catt himself gave a 2 h lecture [9] [actually 3 hour] which was followed by an hour-long lecture by David Walton [10]. These lectures showed a demonstration of the physics of some phenomena, ordinarily known to engineers, such as charging a capacitor, in an unconventional form—namely by applying a step voltage to a TL. The well-known exponential charging was the result of an approximated series of discrete steps **http://www.ivorcatt.org/icrwiworld78dec1.htm** caused by the cyclic process of the travelling TEM wave. This theory was supported by an experiment, known as **Wakefield experiment** [11], **http://www.ivorcatt.co.uk/x343.pdf** ; **http://viewer.zmags.co.uk/publication/3796f068#/3796f068/74** (p72) which led to the conclusion that **there is no such a thing as a static electric field in a capacitor.** **[What does “a capacitor” mean? Are some electric fields static and others dynamic? Horses for [career]**

courses? - IC] In other words, a capacitor is **a form of [!]** TL http://www.ivorcatt.co.uk/x3b2.pdf in which a TEM wave moves with a single fixed velocity, which is the speed of light in the medium. **[Schools and colleges teach the other form of capacitor, the ones that are not a TL - the better behaved square ones entered at the middle, like the symbol, which support all the mathematics.]** Below we reproduce both the derivation of the TL-based capacitor discharge and the description of the Wakefield experiment.

Those lectures triggered my deep interest in studying Oliver Heaviside's work and, even more, his whole life. And this very interest drew me to (then PhD student but now Dr) Christopher Donaghy-Spargo, with whom we founded NEMIG—northeast Electromagnetics Interest Group, which since 2013 has enjoyed a formidable series of seminars given by scientists, engineers, historians and entrepreneurs, driven by the ideas and lives of Maxwell, Heaviside and generally by the exciting field of electromagnetism.

Coming back to the main object of this paper, which is the relationship between energy current and computing, I must admit that I had drawn most of inspiration from my familiarization with Heaviside's work, his legacy in the work of others, and to a great extent by the fact that both Ivor Catt and David Walton came to studying electromagnetic theory from the point of view of energy current through their experiences in dealing with high-speed digital electronics. [http://www.ivorcatt.co.uk/x66111.pdf] This electronics does not deal with sine waves. It deals with **digital pulses, which are physical enough to be dealt with in a 'more physical way'** rather than **expressing them as an algebraic sum of sine wave** harmonics stretching in the time domain from $-\infty$ to $+\infty$.
http://www.ivorcatt.co.uk/x18j197.pdf . Such pulses have a clear starting point in time and endpoint in time. They naturally lend themselves to causality between actions, such as a rising edge of one pulse causes a falling edge of another pulse, for example, as the signal passes through a logic NOT element (inverter). As I spent most of my own 40 working years exploring asynchronous self-timed digital circuits, and such circuits could work directly when the power is applied to their vdd lines, I was firmly attracted by the natural beauty of the ideas of the electromagnetic theory approach relying basically only on energy current, Poynting vector ($S = E \times H$, vector product of the electrical field vector and magnetic field vector, representing the directional energy flux, measured in Watt per square metre; note that it is sometimes referred to as Umov–Poynting vector) and TEM wave—particularly by its compactness and parsimony of Occam's Razor.
Another important aspect of my fascination of the energy-current approach to computational electronics is associated with the fundamental role that mathematical series play there.

Series, so much loved and revered (to the poetic level!) by Heaviside, are at the core of the vision of all electromagnetic phenomena because they relate all state changes in the electromagnetic field with the geometry of the space and medium.

….

Setting the scene, I would like to finish this preface with a quote from David Walton's lecture abstract [**10**]:It is normally recognised that the postulation of Displacement current by James Clerk Maxwell was a vital step which led to the understanding that light was an electromagnetic wave. I will examine the origins of **displacement current** by consideration of the behaviour of the dielectric in a lumped capacitor and will show that it **has no physical reality**. [http://www.ivorcatt.org/icrwiworld78dec1.htm] In the absence of an ether there is no rationale for displacement current. We are then left with a theory which

works mathematically but has no basis in physical reality. I will discuss **the remarkable property of empty space in that it has the ability to accommodate energy.** http://www.forrestbishop.mysite.com/EMTV2/EMTvol2p236-7.jpg . I will then show that Faraday's law and conservation of charge lead to the existence of electromagnetic energy which travels at a **single fixed velocity** and has a determined relationship between the electric and magnetic fields. Because this mathematics is reversible it follows that these two physical laws can be considered to be consequences of the nature of electromagnetic energy rather than the reverse.

[**space …. has the ability to accommodate energy.** Perhaps the lack of this concept is why I cannot understand either side in the "debate" over whether the aether exists. Prior to Yakovlev today, where has this key idea been discussed during the "debate"? Is it irrelevant? - IC]

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Setting the scene, I would like to finish this preface with a quote from David Walton's lecture abstract [**10**]:

It is normally recognised that the postulation of Displacement current by James Clerk Maxwell was a vital step which led to the understanding that light was an electromagnetic wave. I will examine the origins of displacement current by consideration of the behaviour of the dielectric in a lumped capacitor and will show that it has no physical reality. In the absence of an ether there is no rationale for displacement current. **We are then left with a theory which works mathematically but has no basis in physical reality.** I will discuss the remarkable property of empty space in that it has the ability to accommodate energy. I will then show that Faraday's law and conservation of charge lead to the existence of electromagnetic energy which travels at a single fixed velocity and has a determined relationship between the electric and magnetic fields. Because this mathematics is reversible it follows that these two physical laws can be considered to be consequences of the nature of electromagnetic energy rather than the reverse.

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2. Energy-modulated computing

….

….

3. Computing by accumulating and dividing energy

(a) On the creative role of *series*

….

(b) Capacitor as transmission line

The configuration that we want to consider here is shown in **figure 4**.

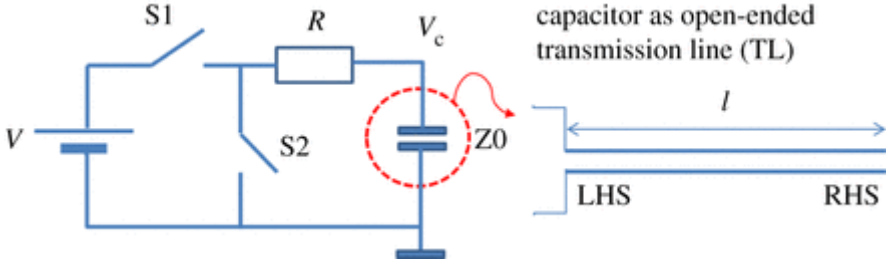

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Figure 4
Circuit for charging and discharging a capacitor seen as a transmission line. (Online version in colour.)

Assume, first, that the capacitor was charged via resistor R to the voltage V (via switch S1). Then we disconnect S1 and connect S2. The capacitor is a (e.g. coaxial cable) TL with a characteristic impedance $Z0$. Let us assume that $R \gg Z0$, and we assume that R is constant. The reflection coefficient at the right-hand side terminals of the open-ended
….

(c) The Wakefield experiment

An experimental evidence of the stepwise discharge process for a capacitor modelled by a co-axial cable has been presented by Ivor Catt in *Electronics World* in April 2013 [11]. Here is only a brief recap of this description. The experiment bears the name of Mr Tony Wakefield of Melbourne, who actually built the configuration and performed all the measurements. Catt wrote: We now have experimental proof that the so-called steady charged capacitor is not steady at all. Half the energy in a charged capacitor is always travelling from right to left at the speed of light, and the other half from left to right [see figure 5]. The Wakefield experiment uses a 75-ohm coax 18 meters long. The left-hand end is an open circuit. The right-hand end is connected to a small, 1 cm long, normally open reed switch. On the far side of the reed switch is a 75-ohm termination resistor simulating an infinitely long coaxial cable. A handheld magnet is used to operate the switch.The coax is charged from a 9 V battery via 2 × 1 megohm resistors, close-coupled at the switch to centre and ground. The two resistors are used to isolate the relatively long battery wires from the coax. High value resistors are used to minimize any trickle charge after the switch is closed.A 2-channel HP 54510B digital sampling scope set to 2 V div^{-1} vertical and
20 ns div^{-1} horizontal is used to capture five images.

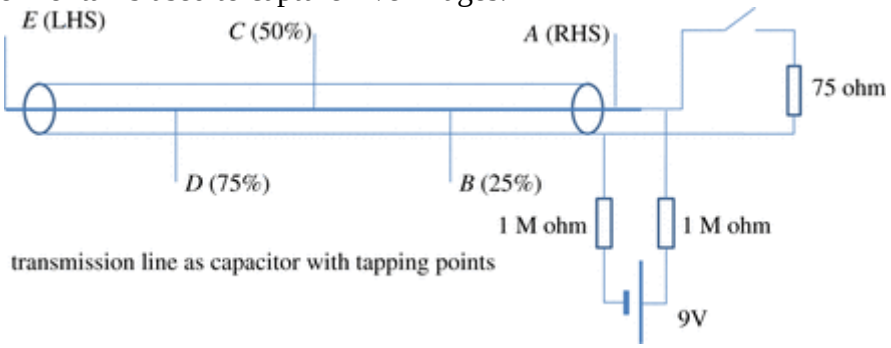

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Figure 5.
Wakefield experiment set-up: coaxial cable as a cap with tapping points. (Online version in colour.)

For the reasons of copyright, I cannot copy these images from Catt's paper. But, they were taken in the following points: (A) across the terminator 75-ohm resistor, (B) 25% to the left of the reed switch (4.5 m), (C) 50% to the left of the reed switch (9 m), (D) 75% to the left of the reed switch (13.5 m), (E) at the extreme left of the open end of the cable (figure 6).

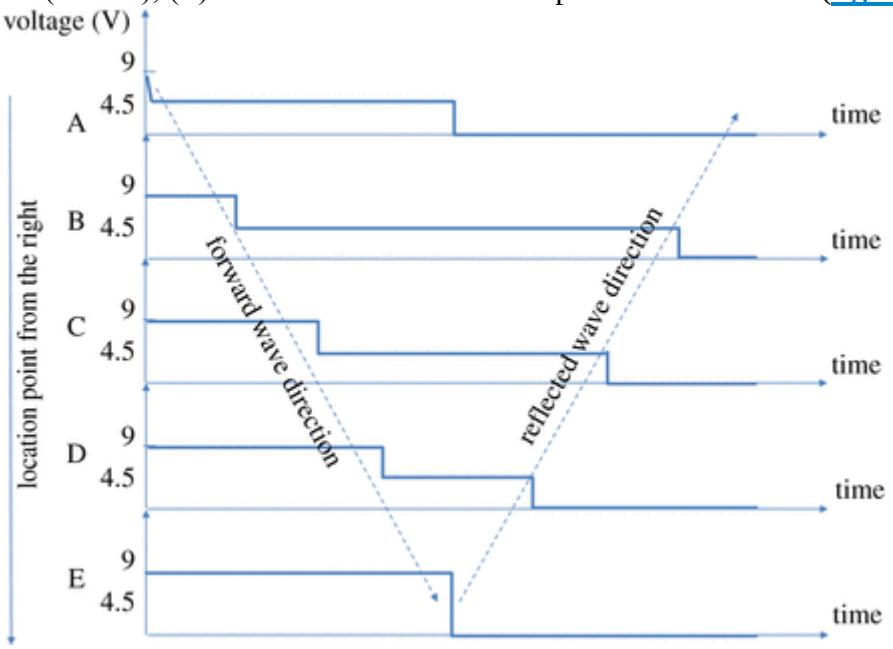

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Figure 6.
Signal plots for the Wakefield experiment, in five different locations. (Online version in colour.)

….

….
In this analysis, performed in a Heaviside way, an intermediate factor, called a switching index *n*, was introduced
….

(e) On quantization and discretization: hypotheses

In this section, I will consider some rather interesting, and possibly controversial, implications of the transients that we visited above thanks to Catt, Davidson and Walton's derivations. The artefact that those transients had envelopes that were exponential or sine/cosine curves was the result of having them been sums of series of steps in the first place. Furthermore, they originated as series of steps from one, rather simple but fundamental, postulate—that of the existence of energy current that is never stationary but always moves with the speed of light (Catt's Theory of [7]).
Understanding this postulate and the various analyses of transients in electrical systems is important. It is crucial for settling with the idea of the world being quantized by virtue of energy currents being trapped between some reflection points, and the continuous pictures of the transients are just the results of some step-wise processes.

I deliberately use word ‘quantized' ….

….
For example, from my discussions with Prof Werner Hofer of Newcastle University, I came to the understanding that electron is a portion of space, surrounding the nucleus of an atom, which has trapped energy current, pretty much analogous to a capacitor!

4. Mathematical models for energy-modulated computing

(a) Modelling Wakefield experiment in Petri-nets

In this section,
….
….
There is a distinct similarity with the waveforms from the scope in the Wakefield experiment shown in **figure 6**. Some discrepancy is caused by a bit coarse level of granularity

5. Conclusion

More than 125 years ago Oliver Heaviside stated that energy current was the primal standpoint. In this paper, we looked at the potential impact of the idea of energy current on the connection between electromagnetic theory and computing. This connection is manifold. It permeates through the notion of energy-modulated computing. It also drives the research into computing which is based on physical phenomena such as causality and encourages the engineers to develop or use the ‘right kind' of mathematics to build the bridge between the behaviour of signals in physics and exploiting this behaviour in computations. The bridge between the physics of electromagnetism and computing fundamentally lies in Time domain analysis and appropriate forms of discretization of processes in space and time (cf. geometric approach of Galileo and Newton [27]). Immediate switching to Frequency domain analysis for pulse-based signals (and this is what we deal with in computers!) would bring a ‘wrong type' of mathematics on the way of physics and reality. This sounds controversial but this is what we could and should learn from Heaviside.
What about more specific methodological innovation of this paper? We have now explored two types of step-wise physical processes that we can link with computing. One is associated with energy-current—this is a fast computing paradigm associated with the speed of light. An example is the energy-division in TLs—here we can form oscillations at super-Gigahertz frequencies on a chip. Another form is associated with the switching of logic gates, where we rely on mass effects such as movement of charge, and division of electrical energy associated with it. This is illustrated by the capacitor discharge via digital switching logic. Here our typical speeds are sub-Gigahertz. These two forms are orthogonal but can work together, for example in a nested way, like the second and minute hands of the clock. We could combine the TL discharge (step-wise discretization of an exponential—inner loop) with a logic circuit switching (step-wise discretization of hyperbolic discharge—outer loop).

This is a conjecture with which I conclude this paper. It is based on the stepwise process of TL models of capacitors by Ivor Catt and his associates and our stepwise processes with a ring oscillator discharging a capacitor, even a lumped one. These are two orthogonal

discretization operators. The study of their superposition is a subject of our future work. This will open up some new dimensions for energy-modulated computing!

Besides, a potentially useful result of this paper in terms of modelling is the fact that Petri net unfolding can be interpreted as a waveform of signals whose states are associated with some places in the net.

Acknowledgements

I am grateful to Dr Christopher Donaghy-Spargo of Durham University for numerous stimulating interactions on the life and work of Oliver Heaviside and our regular chats about electromagnetism. I would also like to thank Mr Ivor Catt and Dr David Walton for opening the world of electromagnetics to me in 2013 through the prism of Catt Theory. I am also indebted to my research group at Newcastle, with whom we are exploring the arcades of energy-modulated computing. Last but not least, many thanks to the two anonymous reviewers for their thorough reading of the paper and producing invaluable comments and corrections.

Footnotes

- One contribution of 13 to a theme issue ‘Celebrating 125 years of Oliver Heaviside's ‘Electromagnetic Theory’’.
- Accepted June 9, 2018.
-

References

1. ↲
1. Yakovlev A
. 2011 Energy-modulated computing. In Proc. Design Automation & Test in Europe (DATE), Grenoble, pp. 1–6. Piscataway, NJ: IEEE. (doi:10.1109/DATE.2011.5763216)
Google Scholar
2. ↲
1. Yakovlev A,
2. Ramezani R,
3. Mak T
. 2011 *Apparatus and method for voltage sensing*. US Patent application US13638330, 28.02.2011, granted US9121871B2 01.09.

Google Scholar
3. ↲
1. Ramezani R,
2. Yakovlev A
. 2013 Capacitor discharging through asynchronous circuit switching. In Proc. IEEE 19th Int. Symp. on Asynchronous Circuits and Systems, Santa Monica, CA, pp. 16–22. Piscataway, NJ: IEEE. (doi:10.1109/ASYNC.2013.11)
Google Scholar
4. ↲
1. Kinniment DJ
. 2008 *Synchronization and arbitration in digital systems*. Chichester, UK: Wiley Publishing. ; http://www.ivorcatt.co.uk/x1bn.pdf
Google Scholar
5. ↲
1. Kinniment DJ
. 2011 *He who hesitates is lost*. Newcastle upon Tyne, UK: Newcastle University, School of Engineering. http://www.ivorcatt.co.uk/x84gglitch.pdf
Google Scholar
6. ↲
1. Catt I
. 1966 Time loss through gating of asynchronous logic signal pulses. IEEE Trans. Electron. Comput. **EC-15**,108–111. (doi:10.1109/PGEC.1966.264407)
Google Scholar
7. ↲
1. Catt I
. 1995 *Electromagnetics 1*. St Albans, UK: Westfields Press.
Google Scholar
8. ↲
1. Catt I,
2. Davidson MF,
3. Walton DS
. 1978 Displacement current – and how to get rid of it. In Wireless World, pp. 51–52. http://www.ivorcatt.co.uk/x3b2.pdf
Google Scholar
9. ↲
1. Catt I
. 2013 Advances in electromagnetic theory. In Video recording of the Electromagnetism Seminar at Newcastle University, 9 October
2013. See http://async.org.uk/IvorCatt+DavidWalton.html.
Google Scholar
10. ↲
1. Walton D
. 2013 Maxwell's electromagnetic theory. In Video recording of the Electromagnetism Seminar at Newcastle University, 9 October 2013. See .

Google Scholar
11. ↲
1. Catt I
. 2013 The end of the road. Electronics World, The Centenary Issue **119**, 72–74. Seehttps://www.electronicsworld.co.uk/magazine/centenary-issue.
Google Scholar
12. ↲
1. Heaviside O
. 1892 *Electrical papers*, **vol. I**. London: Macmillan and Co., p. 438.
Google Scholar
13. ↲
1. Shafik R,
2. Yakovlev A,
3. Das S
. 2018 Real-power computing. IEEE Trans. Comput. **67**, 1445–1461. Early Access. (doi:10.1109/TC.2018.2822697)
Google Scholar
14. ↲
1. Yakovlev A,
2. Vivet P,
3. Renaudin M
. 2013 Advances in asynchronous logic: from principles to GALS & NoC, recent industry applications, and commercial CAD tools. In Proc. Design Automation & Test in Europe (DATE), Grenoble, France, pp. 1715–1724. (doi:10.7873/DATE.2013.346)
Google Scholar
15. ↲
1. Heaviside O
. 1892. *Electrical papers*, **vol. II**. London: Macmillan and Co., p. 201.
Google Scholar
16. ↲
1. Catt I,
2. Davidson MF,
3. Walton DS
. 1979 *Digital hardware design*. London, UK: The Macmillan Press Ltd.
Google Scholar
17. ↲
1. Sullivan CR,
2. Kern AM
. 2001 Capacitors with fast current require distributed models. In Proc. IEEE 32nd Annu. Power Electronics Specialists Conf., Vancouver, BC, pp. 1497–1503. Piscataway, NJ: IEEE. (doi:10.1109/PESC.2001.954331)
Google Scholar
18. ↲

1. Yakovlev A,
2. Kushnerov A,
3. Mokhov A,
4. Ramezani R
. 2014 On hyperbolic laws of capacitor discharge through self-timed digital loads. Int. J. Circ. Theor. Appl. **43**, 1243–1262. (doi:10.1002/cta.2010)
Google Scholar
19. ↲
1. Wang A,
2. Calhoun BH,
3. Chandrakasan AP
. 2006 *Subthreshold design for ultra-low power systems*. Berlin, Germany: Springer Verlag.
Google Scholar
20. ↲
1. Nose K,
2. Sakurai T
. 2000 Optimization of VDD and VTH for low-power and high-speed applications. In Proc. Asia and South Pacific Design Automation Conf. (ASP-DAC), Yokohama, Japan, pp. 469–474. New York, NY: ACM(doi:10.1145/368434.368755)
Google Scholar
21. ↲
1. Xu Y,
2. Shang D,
3. Xia F,
4. Yakovlev A
. 2016 A smart all-digital charge to digital converter. In Proc. IEEE Int. Conf. on Electronics, Circuits and Systems (ICECS), Monte Carlo, pp. 668–671. Piscataway, NJ: IEEE. (doi:10.1109/ICECS.2016.7841290)
Google Scholar
22. ↲
1. Einstein A,
2. Podolsky B,
3. Rosen N
. 1935 Can quantum-mechanical description of physical reality be considered complete? Phys. Rev. **47**, 777–780. (doi:10.1103/PhysRev.47.777)
CrossRefGoogle Scholar
23. ↲
1. Hofer W
. 2018 *Is quantum mechanics creationism, and not science?* ArXiv e-prints, February 2018. Seehttp://adsabs.harvard.edu/abs/2018arXiv180200227H
Google Scholar
24. ↲

1. Petri CA
. 1966 Communication with automata. Dissertation, University of Hamburg. See http://edoc.sub.uni-hamburg.de/informatik/volltexte/2010/155/
Google Scholar
25. ↲
1. Murata T
. 1989 Petri nets: properties, analysis and applications. Proc. IEEE **77**, 541–580. (doi:10.1109/5.24143)
Google Scholar
26. ↲
1. Falk R
. 2018 On the structure of cycloids introduced by Carl Adam Petri. In Proc. 39th Int. Conf. on Applications and Theory of Petri nets and Concurrency, Bratislava, Slovakia.
Google Scholar
27. ↲
1. Dellian E
. 1989 Newton, die Traegheitskraft und die absolute Bewegung. Philosophia Naturalisz **26**, 192–201.See http://www.neutonus-reformatus.de/frameset.html
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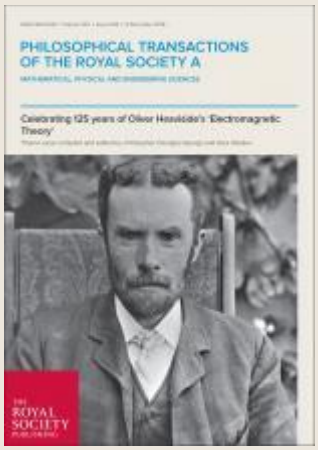

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Dear Mr Catt,

Thank you for the call today regarding your interest in a recent issue of the Philosophical Transactions A journal.

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Authors/Editors Rees, Pepper, Atiyah have all been involved in "The Catt Question". http://www.ivorcatt.co.uk/cattq.htm ; http://www.ivorcatt.co.uk/x6611.htm

Professor Massimiliano Pieraccini

2; In his 2011 novel "L'anomalia" , Massimo, who my translator **Monica.pasin@outlook.com** says represents its author Professor Massimiliano Pieraccini, says;

“M «Are you kidding?» “Nobody with an ounce of common sense would risk their career and scientific reputation to study the Catt anomaly” Massimo thought, “and even if they were spending time on this, they wouldn’t be telling people about it”.”

> “As a "follower of Catt", I recently received my first near-death-threat, in the form of a wish. I expect M. Pieraccini will be pleased to hear this. – Forrest Bishop **"Just the idea of twisting a scientific fact for narrative purposes makes me shudder. After all, my reputation would be at stake. And academia does not take these matters lightly. I am absolutely not going to end up like Catt... or like Kaposka! "- Massimiliano Pieraccini blog**, May 24, 2011 [19] (translated from Italian.) [In Pieraccini’s novel, Kaposka is murdered.]” - Forrest Bishop 7 Nov. 2017

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http://www.ivorcatt.co.uk/x89uned.htm

Pieraccioni IEEE peer reviewed misrepresentation and defamation. Edited for the IEEE by his Florence University colleague Pelosi.

More detail

@@@@@@@@@@@@@@@@@@

Note 1

I have now firmed up the definitions.

By analogy with the AIDS Scam.

Getting into “!AIDS Deniers, there are two groups. I am not sure which group Kary Mullis is in, probably 2.

1. HIV does not exist. Neville Hodgkinson, Eleni Papadopulos-Eleopulos

2. HIV is a passenger virus, not causing AIDS. Duesberg.

Theory C. Electricity does not help a battery to light a lamp.

Theory C+. When a battery lights a lamp, there is no electric current. The “current” is a mathematical manipulation of the field.