Fluxonic processing of photonic synapse events

Notes by Alex

"Such a technique makes efficient use of photons, energy, space, and information."

- is this backed up later?

- Maybe worth re-iterating in the conclusion

Is there a description of a Josephson transmission line?

- remember, almost fully optics audience b/c special issue is about photonics

- references: present, but I probably won't put your paper down to read those

- Even if they're not conceptually important, readers don't know that. They will assume that, if they don't understand this component, that they then can't understand the overall circuit. Then they give up on analyzing the circuits.

"The purpose of this paper is to consider specific cir- cuits implementing a more elaborate model for neural in- formation processing in which the dentritic tree acquires significantly more information about synaptic activities than a simple sliding average"

- \*photonic\* neural information

- acquires -> extracts? processes? leverages? reacts based on?

- synaptic activities -> incoming spiking signals?

- I'm nit picking this because it is the best one-sentence statement of underlying originality of the paper. Shouldn't rely on context too much.

- Placement as-is is just right: leading sentence, on first page.

~~Fig. 2(a) - label the blue dot with V\_si for the sake of Fig.3~~

Fig. 2(c) - are the outputs the same amplitude as the input?

p2, par1: which questions above?

p2, end of par1: Possible to say "inductive" instead of L/r

- or something like ...by setting resistance of an inductive loop. Anything in English.

~~"work is theoretical"~~

~~- not great connotation. stick with "based on simulation"~~

~~p4, bottom: "It is for this reason that we consider\*e\*"~~

~~p5, halfway through par1: "at which point the effective synaptic weigh\*t\* is suppressed"~~

p5, par3: what is a Volterra expansion? Is this word necessary?

Could you comment somewhere anticipating the question I had the other day: what prevents a fluxon in a DR loop from hopping back to one of the SI loops?

Fig. 6, Fig. 7, all the rest - subscripts are too small

Fig. 8 - when the traces disappear, it is unclear if they stay at zero or go negative.

Fig. 11 - is "q" ever defined? Consider putting equation in caption.

Fig. 11(a, b) - "signal" is not very descriptive. do you mean I\_di? Or is it more like a generic fuctions, the values of f(t) and g(t)

p12, par1 - it is not clear why you are trying to approximate a polynomial

- i think this is it "so that information across temporal scales can be accessed," but why can't an exponential do that

p13, par2 - "as the den- dritic tree computes and feeds its signals into the neuron cell body" ultimately resulting in a binary decision to fire or not to fire.

p14, par1 - "inevitably lead to departures in computation." Instead, differences in neural behavior? neuron repertoire?

p14, end of par2 - "Because nanowire single-photon detectors have a binary response, the production of light also results in logic-level restora- tion, but at the neuronal rather than dendritic processing level."

- do you mean the "synaptic rather than..."? It is not clear how the SPDs relate to production of light because the dentrite is in the middle.

last paragraph - the point about dendritic engineering being relevant to theories of biological processing is very good. Consider copying that point to the introduction somewhere.

General comment: when you say computation as in "electronics for computation", I'm not sure I follow. My view is that computation is inseperable from the networking and you can do complex computation even with the simplest integrating neuron, as long as the neuron gain is high enough to experience nonlinearity. In digital, does all computation happen just in the gates, or does it take a circuit of interconnected gates?

- I guess it depends on whether you count fan-in as part of the interconnect; if not, as in SOEN, then yeah the interconnect is just communicating signals without changing them. With WDM though, I'd say computation happens during detection when they are summed and in the interconnecting MRRs when they are multiplied. Just semantics, not something to change in this paper.

Last sentence

- last sentence is always hard. let's talk about it. here is my reaction

- it's preceded by an awesome point that dendritic processing is actually relevant to neuroscience. that might be the idea you want people to walk away with. also, it's supported by and relevant to this paper.

- cleanroom + chalkboard is debateable. You could also argue foundries, markets, classrooms, ... I realize this is not meant to be a serious argumentative point, but what the principle challenges are is actually an important debate. There are better places to take a nuanced stance on it (perspectives, presentations, commentaries, panels...)