

Improving eligibility propagation using Izhikevich neurons in a multilayer RSNN.

Presentation 6: Reproducing Bellec's results

Werner van der Veen
(w.k.van.der.veen.2@student.rug.nl)

January 5, 2021

Work done since previous meeting

- ✓ Implement Bellec's model;
- ✓ Number of major and minor fixes;
- ✓ Normalized input data per channel;
- ✓ Started writing and drafting thesis.

Performance

- Performance goal for e-prop with Bellec's configuration: 36.9% misclassification rate on test set with fixed/random broadcast alignment;
- Currently: approaching that performance as I try and find differences in the code;
- Bellec doesn't report some of the hyperparameter settings, and uses inconsistent notation.
- I wrote additional visualization modules to pinpoint the errors.
- The system can now train and generalize well; just not down to the desired accuracy. I think this is simply a matter of tuning the learning rate.

Performance

(show performance)

Next steps

- ☐ Reproduce Bellec's 36.9% error rate. (est. 1–7 working days)
- ☐ Obtain results comparing the 1, 2, 3 layer architectures. (2–3 days).
- ☐ Obtain results comparing the (A)LIF, ALIF, STDP-LIF, and Izhikevich neurons for 1 layer. (3–4 days).
- ☐ Implement non-uniform synaptic delays (1 day).
- ☐ Implement metaplasticity (1 day).
- ☐ Obtain performance for non-uniform synaptic delay (2 days).
- ☐ ...and for metaplasticity (2 days).
- ☐ Concurrent with the above steps, draft and write parts of the method and introduction of the thesis.

Questions

- Which results are interesting? My proposal:

Number of layers	1, 2, 3. (readout from all or last? (Bellec = all))
Neuron type	(A)LIF, ALIF, STDP-LIF, Izhikevich
Synaptic delay	1, 1–8

- Combining the above?
- Draft the thesis top-down. Start with method?
- To what extent focus on peripheral topics (e.g. Hebbian learning, bioplausibility, dynamical systems theory, etc?) What is a sensible cutoff?
- Does it make sense (it is valid?) to base weight initialization on previous runs?

A possible thesis structure

- Introduction (Explanation of concepts, previous work, relevancy of this work)
 - No formal notation yet, only intuitions
 - What can I assume is known by reader? MSc. graduate level? Or do I need to re-explain ANNs?
- Method (data, Bellec's e-prop, my own improvements)
 - Adhere to Bellec's formal notation.
 - Exact reproducibility is paramount.
 - Can I intersperse the method with theoretical background?
 - Separate subsection under methods for optional settings (e.g. firing rate regularization). Bellec manages this by putting them in "supplementary notes".
 - Hyperparameter sweep procedure.
- Results
- Discussion (interpreting results in light of other research, ideas for future work)
- Conclusion (summary, logical connection to Introduction)
- Appendix (supplementary figures, everything that may be interesting or illustrate findings described in main text)