INTER-LAYER TEMPORAL CORRELATION MEASUREMENTS REVEAL CONNECTIVITY FIELDS

Georgios Loupas[1], *Epistimi-Anna Makedona*[1], *Ganna Palagina*[3], *Stelios M. Smirnakis*[3], *Maria Papadopouli*[1,2,*]

[1] Institute of Computer Science, Foundation for Research and Technology-Hellas, Greece
[2] Department of Computer Science, University of Crete, Greece
[3] Department of Neurology, BandW/JP Hospitals, Harvard Medical School, Boston MA, USA
[*] mgp@ics.forth.gr

Inter-layer functional connectivity analysis has the potential to uncover input output relationships across layers. To examine the functional connectivity, we estimate the temporal correlation based on an extension of the Spike Time Tiling Coefficient [1], a metric superior to commonly-used measures, as it accounts for relative time shifts, local fluctuations of neural activity or noise, and presence of periods without firing events. Two neurons are functionally connected (*i.e.*, linked by an edge), if their firing activity has a statistically significant temporal correlation compared to a circularly shuffled null distribution of STTC values (control). The firing of neurons located in different layers present substantial temporal correlation (*e.g.*, Fig. 1, left). For each neuron of L2/3 and L5 (reference neuron), we identify the group of neurons in L4 with which it has significant pairwise temporal correlations (*putative connectivity input field* of the reference neuron). Both L2/3 and L5 neurons have multiple significant STTC connections with neurons residing in L4. Furthermore, the probability of firing of both L2/3 and L5 neurons rises sharply as a function of the aggregate number of firing events noted in their corresponding putative connectivity input fields. This probability can be modeled using a sigmoid function. Note that the corresponding relation to the aggregate firing of a control set of L4 neurons remains flat. We comparatively analyze the functional intra- vs. inter-layer architectures and how the identified connectivity fields relate to neuronal response properties.

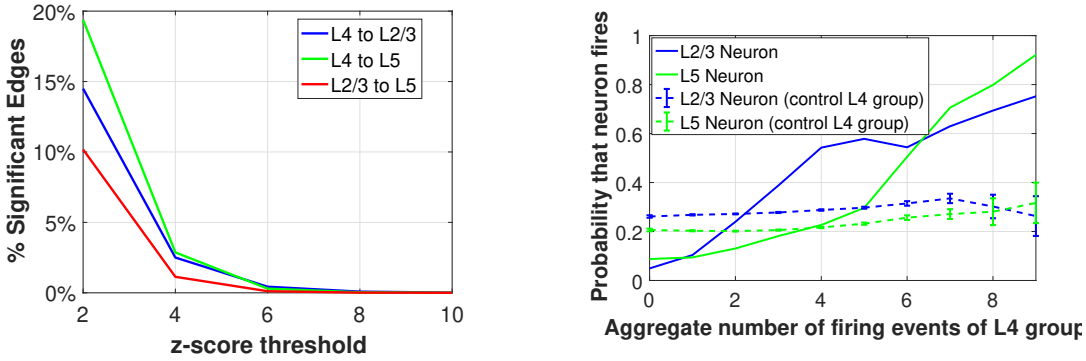

Figure 1. (Left) Significant interlayer edges at different z-score thresholds. (Right) Errorbars refer to 95% confidence interval of the mean. L2/3 and L5 neurons have firing rate of 1.74 and 1.31 Hz, respectively.

Acknowledgment

Funded by the HFRI and GSRT, and NINDS R21.

Reference

1. Cutts, Eglen, 2014, *J. Neurosci.* 34(43):14288–14303, 10.1523/jneurosci.2767-14.2014