USING RQA TO IDENTIFY THE STRUCTURE OF 4-AP INDUCED SEIZURE EVENTS

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Our understanding of how neurons interact to generate and propagate epileptic seizures is limited. It is important to understand what changes in the cortical circuit allow a highly-correlated firing state to emerge, evolve, and recur after focal-cortical injury. This work aims to measure how cortical neurons are recruited *in vivo* during neocortical focal seizure events in mice. To do so, we employ the 4-aminopyridine (4-AP) model [3]. We perform simultaneous EEG and two photon calcium imaging measurements under three conditions, namely no experimental manipulation, vehicle injection, and 4-AP injection in area V1. Each recording lasts approximately 10 min. Here we report our preliminary analysis on one mouse. To assess the temporal correlation of neuronal activity, we employ the Spike Time Tiling Coefficient (STTC) [1], a metric that accounts for relative time shifts, local fluctuations, and presence of periods without firing events. Two neurons are considered functionally connected and represented by a network edge, if their firing activity has a statistically significant STTC value. Compared to the functional connectivity during spontaneous condition, the functional networks after vehicle and after 4-AP injection are significantly denser (Fig. 1 left)). To identify the dynamical neuronal behavior of ictal phases, we apply Recurrence Quantification Analysis (RQA) [2], a powerful tool based on the analysis of the underlying signal dynamics. RQA specifies the beginning and end of events in the EEG and in the population calcium spike trains (Fig. 1 (right)). The characterization of these events based on neuronal population activity and EEG spectral characteristics is in progress. Our long-term goal is to identify neuronal activity patterns that reliably predict seizure events.

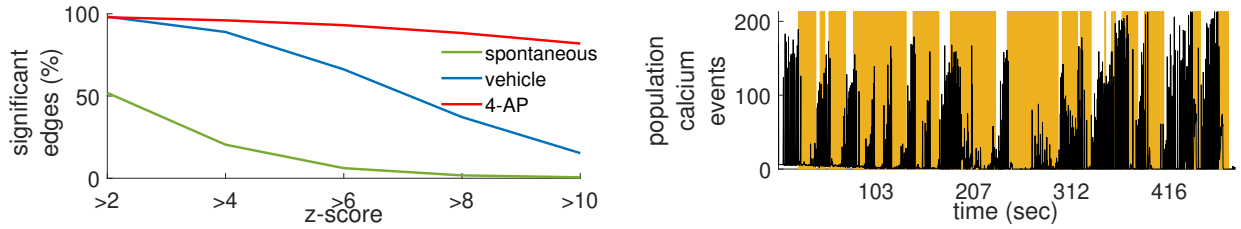

Figure 1. (Left) Significant edges percentage for different z-score thresholds. (Right) Population calcium events; Orange regions mark identified RQA events.

Acknowledgment

Funded by the HFRI and GSRT, Fondation Santé, and NINDS R21.

References

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