Abstract

We demonstrate an open-source, cross-platform solution for online sharp-wave ripple (SWR) detection. Specifically, we show low closed-loop latency (~2 ms) along with low overall detection latency (~35-60 ms) and accurate in vivo detections (<5 false detections per minute and >0.95 true positive rate). Overall, our system is capable of disrupting more than half of a SWR.

System Architecture

Neuroelectrophysiological recordings from CA1 are sent to a computer. Trodes software is used for data acquisition. Our module detects and initiates disruption pulses for intervention done by microcontroller and stimulator.

Single Channel In Vivo

Algorithmic evaluations reveal a threshold of 4 standard deviations above the mean will report ~4.7 false detections per minute while detecting greater than 95% of ripple events.

Two Channel In Vivo

In the multichannel case, we enable multiple channels to vote on ripple events prior to sending a stimulation pulse. Higher accuracy is achievable at lower thresholds with similar detection latencies.

Conclusion & Future Works

We have built an open-source, closed-loop system for online SWR detection. We have evaluated algorithmic performance and identified tradeoffs that impact efficacy of ripple disruptions. Future works involve lowering false detection counts through algorithmic improvements (e.g., adding a false stimulation detection channel and adding real-time threshold timing requirements).

References