

¹S. Dutta, ²C.-T. Wu, ⁴D. Liu, ⁸M. Karlsson, ^{5,6,7}L. Frank, ⁹M. Van Der Meer, ^{2,3}D. Ji, and ^{1,2}C. <u>Kemere</u> ¹Department of Electrical and Computer Engin., Rice Univ. ²Department of Neurosci., ³Mol. and Cell. Biol. Baylor College of Medicine, Houston, TX, ⁴Bioengineering, ⁵Howard Hughes Med. Inst., ⁶Kavli Inst. for Fundamental Neurosci., ⁷Physiol., Univ. of California San Francisco, ⁸SpikeGadgets, LLC., San Francisco, CA, ⁹Psychology & Brain Sci., Dartmouth Col. Hanover, NH.

Abstract

We demonstrate an open-source, cross-platform solution for online sharp-wave ripple (SWR) detection and disruption.

Specifically, we show that our system can achieve **perfect** detection accuracy and low latency (~40-60 ms) in online **detections** of SWR activity in a **synthetic** "gold-standard" dataset (matching state-of-the-art latencies). In vivo, our system shows low detection latencies (~35-60 ms) with **low false stimulation rates** (<1/sec). Additionally, we show that our system's latency is within ms of threshold crossing.

Background & Motivation What are **sharp-wave ripples (SWRs)**?

Coordinated bursts of neural activity in the hippocampus that stem from the CA3 region causing oscillations in the CA1 region. These events are \sim 150-250 Hz and last \sim 100 ms.^{[A],[B],[O]}

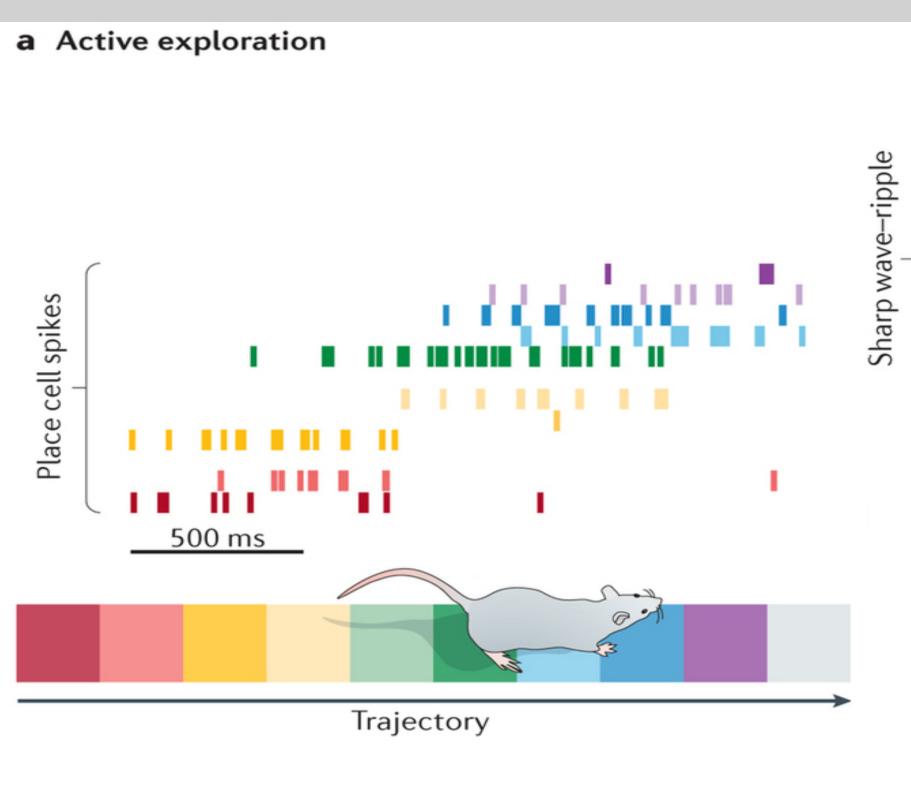
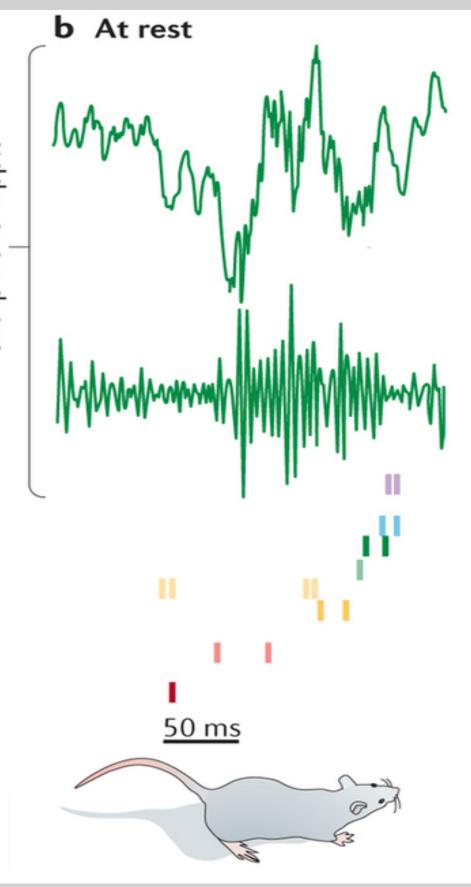


Figure adapted from Colgin Nature Reviews Neuroscience 2016 [A]



Why do we care about them?

The CA1 neurons active during a SWR can be the same ones active while an animal is going through a spatial navigation task. This implies that SWRs are associated with a subject replaying a past experience. This association has been causally linked through online detection and disruption of SWR activity.^[D] Further studies with closed-loop control are required to determine the extent to which SWRs contribute to memory consolidation and decision making based on past experiences.

System Architecture

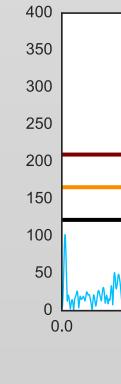
Hippocampal neural data (LFP) is collected and sent to a computer (1-3).

Trodes software is used to detect SWR events and initiate a stimulation pulse (4-6)

A microcontroller triggers a biphasic stimulator to disrupt the SWR (7-8).

Detection Algorithm

and



Low-Latency, Open-Source, Real-Time Sharp-Wave Ripple Detection System

