Docket #: S18-232

Robust, on-line, real time system and method for neuron spike recovery

Stanford researchers at the Moore Lab have developed an algorithm for on-line, real time post processing of large amounts of neuronal data from high-density, multi-channel electrophysiological recordings to identify which neurons were firing (on-line spike recovery). The researchers were able to demonstrate on-line spike recovery recorded from hundreds of neurons on hundreds of channels simultaneously using convolutional compressed sensing for sparse signal recovery. The proposed algorithm demonstrated accurate and robust signal recovery comparable to manual spike sorting despite continuously updated measurements. Additionally, the proposed algorithm inherently allows for resolution of spatio-temporal overlapping activity. In combination with an offline spike-sorting initialization, this algorithm provides the means necessary for utilization of single-cell activities in online applications such as closed-loop neuroscience or brain-machine interfaces.

Stage of Research

- **Proof-of-concept** – method tested using offline data recorded from awake behaving monkeys, offline data recorded with high-density multi-channel electrodes in rodents and online data recorded in anesthetized monkeys with high-density multi-channel electrodes
- Planning **in-vivo testing** in an online setting involving awake behaving monkeys

Applications

- **Post processing of neuron data** for complex new hardware- high-density, multi-channel electrodes
- **Closed loop neuroscience research** - real time, on-line electrophysiological recordings can guide experiments
- **Brain Machine Interfacing** (BMI)

- Secondary applications can include other modalities which necessitate the extraction of neuronal spiking activity, such as two-photon calcium imaging

Advantages

- **Real-time, accurate, on-line post processing** of neuron data enables guidance for BMI and closed loop neuroscience
- **Computationally efficient**
- **Works with new complex hardware** - high-density, multi-channel electrodes
- **Scalable** to hundreds of channels and neurons
- Allows for **resolution of spatio-temporal overlapping activity**
- Uses novel concepts from sparse signal recovery and compressed sensing to recover the spiking activity as a sparse signal
- Can be applied to a variety of recording settings including different animal models

Publications

- S. Weingärtner, X. Chen, M. Akcakaya, T. Moore Robust Online Spike Recovery for High-Density Electrode Recordings using Convolutional Compressed Sensing *IEEE/EMBS Int Conf Neural Eng (NER* May 20, 2019.

Patents

- Published Application: 20200289011
- Issued: 11,564,608 (USA)

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