Spike sorting

Where extracellularly recorded action potentials are ascribed to individual neurons.

Recording extracellulary from neurons in the brains of animals in vivo is among the most established experimental techniques in neuroscience, and has recently become feasible in humans. Many interesting scientific questions can be addressed only when extracellular recordings last several hours, and when individual neurons are tracked throughout the entire recording. Such questions regard, for example, neuronal mechanisms of learning and memory consolidation, and the generation of epileptic seizures. Several difficulties have so far limited the use of extracellular multi-hour recordings in neuroscience: Datasets become huge, and data are necessarily noisy in clinical recording environments. No methods for spike sorting of such recordings have been available.

Spike sorting refers to the process of identifying the contributions of several neurons to the signal recorded in one electrode. To overcome these difficulties, Niediek et al. developed Combinato: a complete data-analysis framework for spike sorting in noisy recordings lasting twelve hours or more. Our framework includes software for artifact rejection, automatic spike sorting, manual optimization, and efficient visualization of results. Our completely automatic framework excels at two tasks: It outperforms existing methods when tested on simulated and real data, and it enables researchers to analyze multi-hour recordings.

They evaluated the methods on both short and multi-hour simulated datasets. To evaluate the performance of the methods in an actual neuroscientific experiment, they used data from from neurosurgical patients, recorded in order to identify visually responsive neurons in the medial temporal lobe. These neurons responded to the semantic content, rather than to visual features, of a given stimulus. To test the methods with multi-hour recordings, they made use of neurons in the human medial temporal lobe that respond selectively to the same stimulus in the evening and next morning [1].

1)
Niediek J, Boström J, Elger CE, Mormann F. Reliable Analysis of Single-Unit Recordings from the Human Brain under Noisy Conditions: Tracking Neurons over Hours. PLoS One. 2016 Dec 8;11(12):e0166598. doi: 10.1371/journal.pone.0166598. PubMed PMID: 27930664.