

Key takeaways

- Single unit electrophysiology
- Recording Local Field Potential and Spikes
- Patch Clamp recordings - current and voltage

Single unit electrophysiology

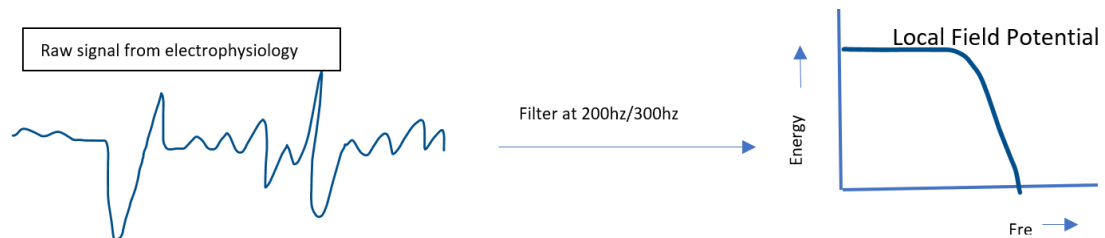
- Single-unit recording involves sampling the activity of single neurons, or small clusters of neurons, using an array of microelectrodes implanted in the brain.
- Metal electrodes are used to record the spiking activity (action potential) from single units.
- An electrode introduced into the brain of living animals, can record the electrical activity happening near the tip of the electrode.
- If the tip is placed near to a single neuron extracellularly , then we get single unit recording
- The difference in potential in the extracellular space of a neuron with reference to the ground is measured.
- The recorded action potentials are similar to the action potentials of a cell , but they are much smaller .
- Microelectrodes are very fine wires made of tungsten or platinum-iridium alloys that are insulated except at the tip of the electrode.
- When there are more neurons near the electrode tip, there would be another set of spiking information(different shape or different time) would also be present in the data
- With spike sorting techniques, we can differentiate the spiking activity of different neurons .
- The recordings could be from dendrites, multiple neurons or axons , since we are not sure about the placement of electrodes. The electrode may or maynot capture the spiking activity or a single neuron or more number of neurons, but very limited.

Multiple channel electrodes

- Multiple channels are present in a single electrode and these are present in different configurations.
- This allows neuronal populations to be considered during electrophysiology experiments.
- Drawbacks include damage to brain tissues and more recovery time from the damages.

- But the major advantage is the data (spiking information) being acquired from more neurons simultaneously.

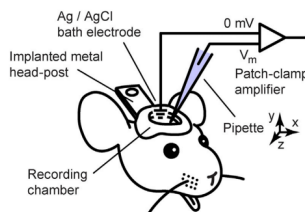
Local field Potential



- The raw signal from the electrophysiology contains high frequency spiking information and low frequency information known as local field potentials(LFP).
- LFP are "extracellular" signals, meaning that they are generated by transient imbalances in ion concentrations in the spaces outside the cells, that result from cellular electrical activity. LFP are 'local' because they are recorded by an electrode placed nearby the generating cells.

Patch clamp Technique

- Possible to record from a single neuron to exactly get the voltage difference ($V_{out} - V_{in}$) .[1]
- Its is extremely difficult to record at this level for human subjects or even in awake behaving animals [2].



- Whole-cell recordings can be obtained from awake head-restrained mice [3].
- Voltage clamps:- Voltage across membrane is kept constant and current through the membrane can be measured.

- Current clamp :-Current flow is kept constant and voltage across the membrane is measured.

References

1. https://experiments.springernature.com/articles/10.1007/7657_2011_7
2. <https://www.sciencedirect.com/science/article/pii/S0896627306005435>
3. [https://www.cell.com/neuron/pdf/S0896-6273\(17\)30601-3.pdf](https://www.cell.com/neuron/pdf/S0896-6273(17)30601-3.pdf)
4. **For more on recording :-**
<https://www.nature.com/articles/s41583-019-0140-6>