# BIO-482 Neuroscience: cellular and circuit mechanisms

# Mini-project: Neurophysiological data analysis

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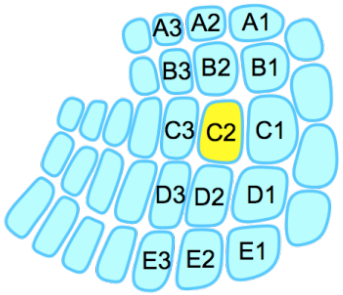
Laboratory of Sensory Processing

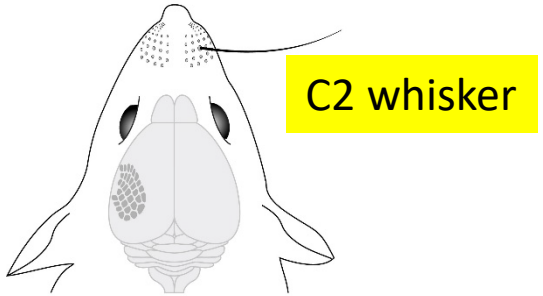
# Recordings

Primary somatosensory area (wS1) ***"Barrel cortex"***

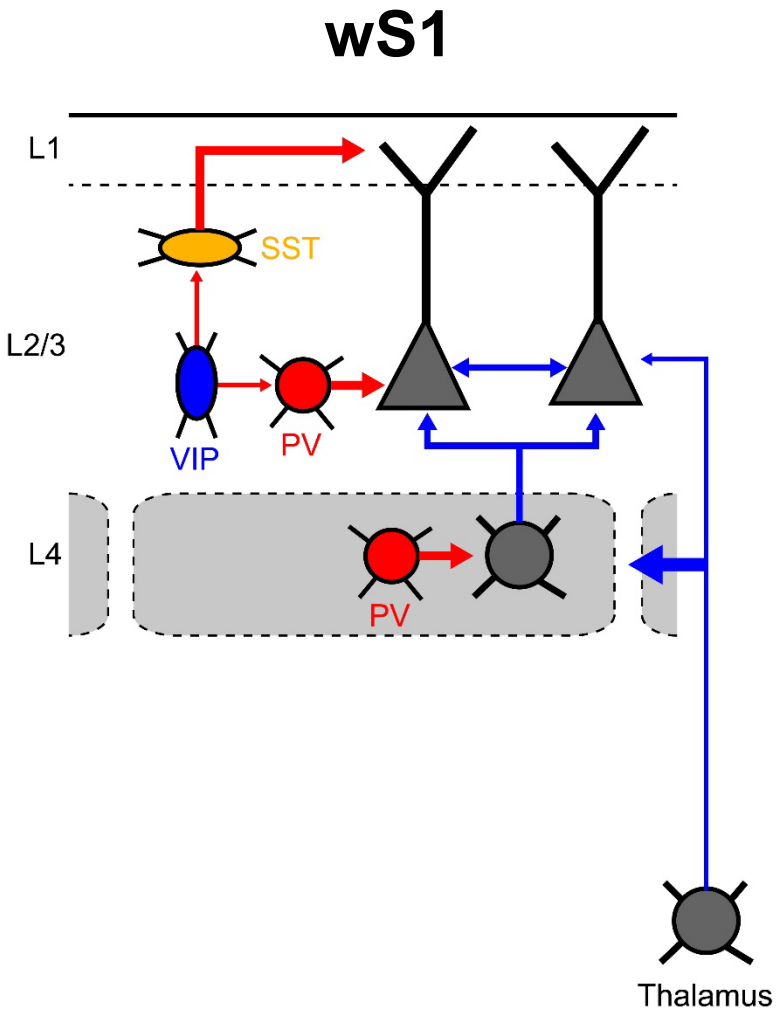
**Cortex**




**Thalamus** VPM/POM



C2 whisker

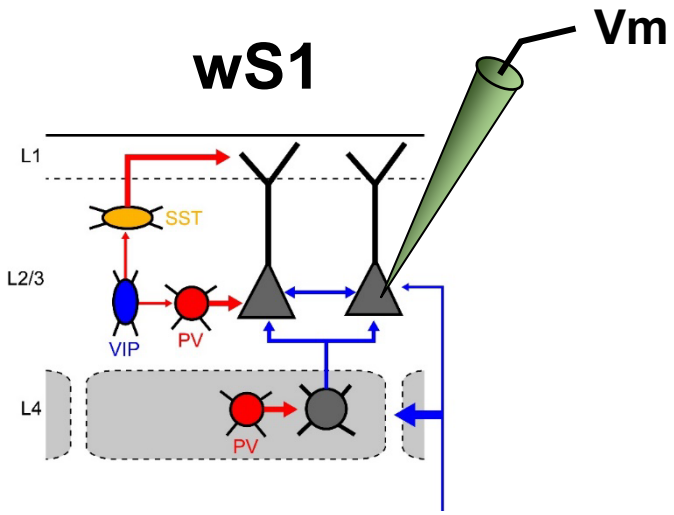


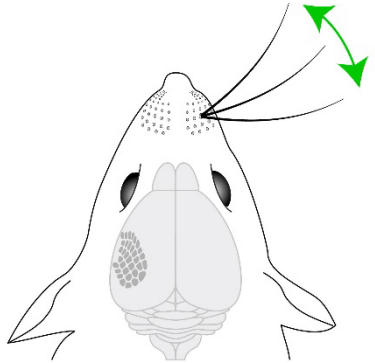

Excitatory cells (EXC)

Inhibitory interneurons:

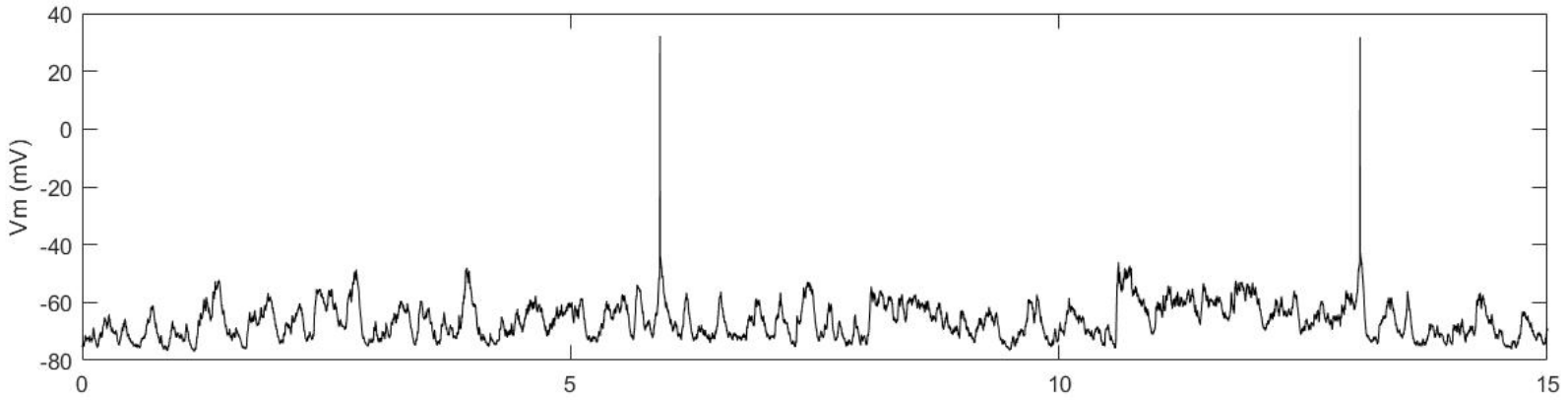
- Parvalbumine (PV)
- Vasointestinal peptide (VIP)
- Somatostatin (SST)

# Recordings : 1 continuous recording = 1 sweep

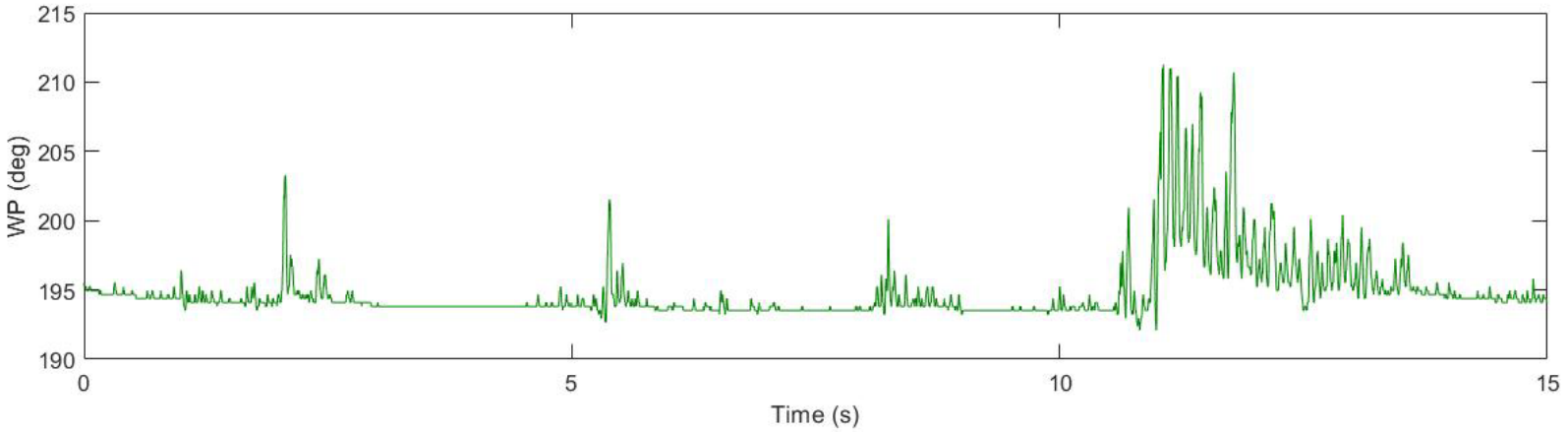


Membrane Potential (Vm)

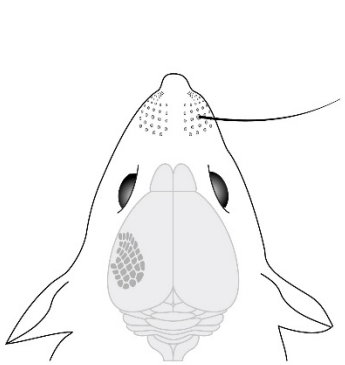



Whisker angle Position (WP)

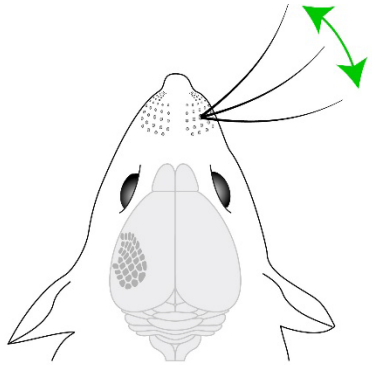


# Sweep types

Free whisking

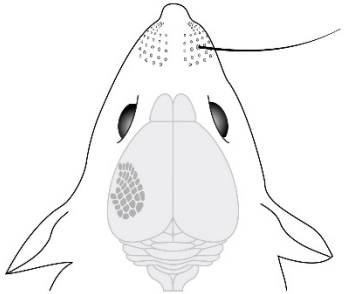


Quiet

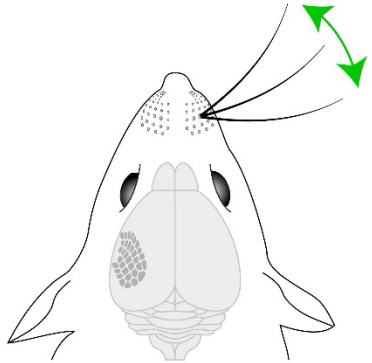


Whisking

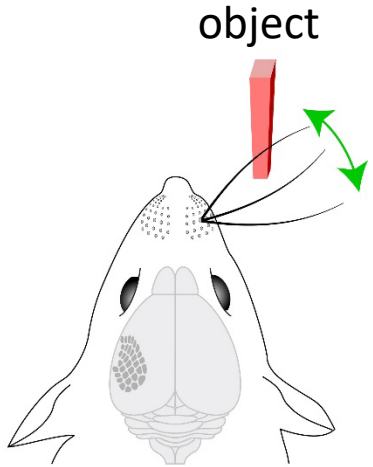
Active touch



Quiet



Whisking




Active Touch

# Data structure => flat data structure : 1 line = 1 sweep

| | Field 1 | Field 2 | … | Field N |
|---|---|---|---|---|
| sweep 1 | | | | |
| sweep 2 | | | | |
| … | | | | |
| … | | | | |
| … | | | | |
| sweep N | | | | |

=> Each Field can contain Meta-Data or Data of different types: String, Number, Vector …

1 sweep = 1 continuous recording from 1 neuron (~30-90 s)

Meta-Data

| Mouse Name | Mouse DOB | Mouse … | Cell Counter | Cell Type | Cell Depth | Cell ID | Cell … | Sweep Counter | Sweep Type | Sweep … |
|---|---|---|---|---|---|---|---|---|---|---|
| TK355 | | | 1 | EXC | 145 | | | 1 | Free Whisking | |
| TK355 | | | 1 | EXC | 145 | | | 2 | Active Touch | |
| TK355 | | | 1 | EXC | 145 | | | 3 | Free Whisking | |
| TK355 | | | 2 | PV | 204 | | | 1 | Free Whisking | |
| TK358 | | | 1 | SST | 126 | | | 1 | Active Touch | |
| TK358 | | | 1 | SST | 126 | | | 2 | Active Touch | |

Mouse | Cell | Sweep

| Mouse Name | Mouse DOB | Mouse … | Cell Counter | Cell Type | Cell Depth | Cell ID | Cell … | Sweep Counter | Sweep Type | Sweep … |
|---|---|---|---|---|---|---|---|---|---|---|
| TK355 | | | 1 | EXC | 145 | | | 1 | Free Whisking | |
| TK355 | | | 1 | EXC | 145 | | | 2 | Active Touch | |
| TK355 | | | 1 | EXC | 145 | | | 3 | Free Whisking | |
| TK355 | | | 2 | PV | 204 | | | 1 | Free Whisking | |
| TK358 | | | 1 | SST | 126 | | | 1 | Active Touch | |
| TK358 | | | 1 | SST | 126 | | | 2 | Active Touch | |

# Data structure

Meta-Data → Data

| Mouse Name | Cell Counter | Sweep Counter | Sweep Type | Whisker Angle | Whisker Angle SR | Vm | Vm SR | Whisking Times | Contact Times |
|---|---|---|---|---|---|---|---|---|---|
| TK355 | 1 | 1 | Free Whisking | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 double | [ ] |
| TK355 | 1 | 2 | Active Touch | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 double | Nx2 double |
| TK355 | 1 | 3 | Free Whisking | 15000x1 double | 500 | 1200000x 1 double | 40000 | Nx2 Double | [ ] |
| TK355 | 2 | 1 | Free Whisking | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 Double | [ ] |
| TK358 | 1 | 1 | Active Touch | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 Double | Nx2 double |
| TK358 | 1 | 2 | Active Touch | 45000x1 double | 500 | 3600000x 1 double | 40000 | Nx2 double | Nx2 double |

# Data structure

| Mouse Name | Cell Counter | Sweep Counter | Sweep Type | Whisker Angle | Whisker Angle SR | Vm | Vm SR | Whisking Times | Contact Times |
|---|---|---|---|---|---|---|---|---|---|
| TK355 | 1 | 1 | Free Whisking | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 double | [ ] |
| TK355 | 1 | 2 | Active Touch | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 double | Nx2 double |
| TK355 | 1 | 3 | Free Whisking | 15000x1 double | 500 | 1200000x 1 double | 40000 | Nx2 Double | [ ] |
| TK355 | 2 | 1 | Free Whisking | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 Double | [ ] |
| TK358 | 1 | 1 | Active Touch | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 Double | Nx2 double |
| TK358 | 1 | 2 | Active Touch | 45000x1 double | 500 | 3600000x 1 double | 40000 | Nx2 double | Nx2 double |

⇒ 1 Cell TK355_1

⇒ 1 Cell TK355_2

⇒ 1 Cell TK358_1

# Data structure

| Mouse Name | Cell Counter | Sweep Counter | Sweep Type | Whisker Angle | Whisker Angle SR | Vm | Vm SR | Whisking Times | Contact Times |
|---|---|---|---|---|---|---|---|---|---|
| TK355 | 1 | 1 | Free Whisking | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 double | [ ] |
| TK355 | 1 | 2 | Active Touch | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 double | Nx2 double |
| TK355 | 1 | 3 | Free Whisking | 15000x1 double | 500 | 1200000x 1 double | 40000 | Nx2 Double | [ ] |
| TK355 | 2 | 1 | Free Whisking | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 Double | [ ] |
| TK358 | 1 | 1 | Active Touch | 30000x1 double | 500 | 2400000x 1 double | 40000 | Nx2 Double | Nx2 double |
| TK358 | 1 | 2 | Active Touch | 45000x1 double | 500 | 3600000x 1 double | 40000 | Nx2 double | Nx2 double |

**'Free whisking' sweeps in Cell TK355_1**

# Data structure – fields description

**Data.Mouse_Name :** Name of the mouse ('LLNNN')

**Data.Mouse_DateOfBirth :** Mouse date of birth [Year; Month; day]

**Data.Mouse_Sex :** Mouse sex ('f' or 'm')

**Data.Mouse_Genotype :** Mouse genotype [Parent1 ; Parent2]

**Data.Cell_Counter :** Cell counter (Numb)

**Data.Cell_Type :** Cell Type ['EXC', 'PV', 'VIP' or 'SST']

**Data.Cell_Depth :** Cell recording depth ( in µm from brain surface)

**Data.Cell_Layer :** Cell cortical layer ['L2/3', 'L4' or 'L5']

**Data.Cell_TargetedBrainArea :** Cell cortical area ['C2 barrel column of wS1']

**Data.Cell_tdTomatoExpressing :** Expression of tdTomato ['true' or 'false']

**Data.Cell_ID :** unique Cell ID (Mouse_Name _ Cell_Counter)

**Data.Cell_APThreshold_Slope :** Threshold to detect AP initiation from dVm/dt ($V.s^{-1}$)

**Data.Sweep_Counter :** Recording sweep counter (Numb)

**Data.Sweep_Type :** Recording sweep type ['free whisking' or 'active touch']

**Data.Sweep_StartTime :** Recording sweep start time [Year; Month; day; hour; minute; second]

**Data.Sweep_MembranePotential :** Membrane potential recording (vector; V)

**Data.Sweep_MembranePotential_SamplingRate :** Sampling rate of membrane potential ($sample.s^{-1}$)

**Data.Sweep_WhiskerAngle :** Whisker angle position (vector, deg)

**Data.Sweep_WhiskerAngle_SamplingRate :** Sampling rate of whisker angle ($sample.s^{-1}$)

**Data.Sweep_QuietTimes :** Onset and Offset times of quiet periods (2xN matrix, s)

**Data.Sweep_WhiskingTimes :** Onset and Offset times of whisking periods (2xN matrix, s)

**Data.Sweep_ActiveContactTimes :** Onset and Offset times of active contacts (2xN matrix, s)

**Data.Sweep_PassiveContactTimes :** Onset and Offset times of passive contacts (2xN matrix, s)

**Data.Cell_Anatomy :** Cell anatomy for identified cells ['layer'; 'barrel column']