Allen Institute ‘*In vitro* Single Cell Characterization’ pipeline datasets

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Jim Berg
The IVSCC project: Central to the components aim

Computation:
- emergent computations
- top-down signals
- sensory representation

Components:
- Synaptic inputs
- Intrinsic Ephys properties
- Cell morphology
- Transcriptional profiling
- Retrograde labeling
- circuits
- cell types
- synapses

Cognition:
- object recognition
- attention
- learning

The Allen Institute for Brain Science
Fueling Discovery
Anatomy of the IVSCC pipeline

- Mouse Prep
- Human Tissue Prep

Brain Slicing → Record / Biocytin fill → Tissue Staining, Imaging → 3D Reconstruction

- Reagent prep team
- Buffer Solution prep
- Ephys team
- Histology & Imaging teams
- MAT (Computational Neuroanatomy) & Annotation team

Data

- Modeling
  Biophysically detailed and GLIF point neurons
- Cell Classification
- Public Data Release
- Technology team

MAT & MCT

Mouse Prep

Human Tissue Prep

Buffer Solution prep

- Mouse Prep
- Human Tissue Prep

1 mm
Common protocols allow for comparisons across species

**Instantaneous threshold**

-79 mV

200 pA steps

**Adaptive threshold**

-79 mV

400 ms

100 pA

**Subthreshold, Rheobase & Suprathreshold**

-78 mV

20 mV

50 ms

**Noise stimuli**

-78 mV

20 mV

400 ms

100 pA mean amplitude, 0.2 CV

Sst-Cre+

V1 neuron
Controlling IVSCC Data Quality

Test pulse reported with start of every sweep

10 mV
500 ms

Test pulse reported with start of every sweep

20 pA
5 ms

4 mV
5 ms

Metadata

**Experiment**
- Electrode resistance
- Seal resistance
- Initial series resistance

**Sweep**
- Amplifier Settings
- Bias Current
- Bridge Balance
- Capacitance Compensation
- Chamber Temperature
- Sweep Name
- Timestamp
## Data curation

<table>
<thead>
<tr>
<th>Manual QC check (recorded in MIES)</th>
<th>Instrument settings</th>
<th>Data reports</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Per experiment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge balance correct?</td>
<td>Access Resistance: 1-20 M ohm, and &lt; 15% of IR</td>
<td>HF Noise +/- 0.2 mV</td>
</tr>
<tr>
<td>Per sweep</td>
<td>Leak: Bias current &lt; 200 pA</td>
<td>V$_{rest}$: beginning and end within 0.5 mV</td>
</tr>
<tr>
<td>Per set</td>
<td>Access Resistance: +/- 3 Mohm</td>
<td>V$_{rest}$: within +/- 2 mV</td>
</tr>
<tr>
<td>Fraction passed sweeps</td>
<td>Leak: within 10%</td>
<td></td>
</tr>
</tbody>
</table>
Mouse IVSCC plans

Mouse IVSCC Goal: Characterize the cell types that make up layers of primary visual cortex
Wishlist for a standard ephys data format

**Standardized capture of experiment / trace metadata**
- Amp settings, slice environment, ion concentration (anything in a methods section)

**Translatable across platforms**
- Axon, HEKA, Igor, Matlab, LabView

**Easy to implement by a brand-new physiology lab**
- Captive audience with limited resources
Mouse IVSCC plans

Strategy: A phased approach to mouse cell type characterization

Phase I: Conservative adaptive
10 – 20 neurons per Cre line
Goal: Establish diversity of each Cre line

Phase II: Rigid within Cre line
30+ neurons per line
Goal: Close to identical backbone protocols within a Cre line

- Collaborations with modeling and theory group
- Playback of stimuli from *in vivo* patch clamp recordings

Lu Li