Functional Models of Mouse Visual Cortex
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Data collected at 3.7fps, video playing at 30fps.
Average of spontaneous and evoked Calcium activity (7.6K samples at 3.7 fps).

Automatically extracted ROIs (cell hypothesis) using Foopsi.

~100 neurons
Automatically inferred spikes using Foopsi for spontaneous and evoked activity. Gratings start after red line.
• Each neuron is a node in a graph
• Edges encode conditional functional dependencies
• No hidden nodes
• Static model
CRF model

Tree model:
train likelihood: -5.3206
test likelihood: -6.4686
true test likelihood: -15.7394

Loopy model:
train likelihood: -3.0674
test likelihood: -4.8702
true test likelihood: -16.0309
Accuracy of inferring individual neurons, given the rest.
Spontaneous activity model.
Validation

Accuracy of inferring individual neurons, given the rest. 90 degree gratings model.
Validation

Mean accuracy of inferring individual neurons over 120 test frames.
Data

Automatically inferred spikes using Foopsi for spontaneous and evoked activity. Gratings start after red line.
Accuracy of inferring individual neurons, given the rest.
0 degree model.
Accuracy of inferring individual neurons, given the rest. 135 degree model.
Accuracy of inferring individual neurons, given the rest.
45 degree model.
Sampled neural activity from tree model
Neurons that fire > 50% of the time, per stimulus model

Spontaneous

0 degree

45 degree

135 degree
Work in progress

- Models for natural image stimuli.
- Models across V1 layers, 300-500 neurons per layer, ~4K per animal (Paul Allen Institute dataset).
- Encode expert knowledge during structure learning.
V1 orientation tuning
V1 orientation tuning

- Encode expert knowledge during structure learning.

90 degree, layer 1 tree model, orientation selectivity

135 degree, layer 1 tree model, orientation selectivity
Normalized Projection Density = \frac{(NPV)}{\frac{\text{Target volume}}{\text{Target fluor.}}} = \frac{\text{Target fluor.}}{\text{Target vol.}} \div \frac{\text{Source fluor.}}{\text{Source vol.}}
“Wiring diagram”

Glickfeld et al 2013
“Wiring diagram”

90° Stimulus

180° Stimulus

Glickfeld et al 2013
Thank you!