Sparse Representation of Sounds in the Unanesthetized Auditory Cortex

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Methods
Awake head-fixed rat

Spikes are easy to detect in cell-attached recording

Spike shapes can vary in a single cell

Stimuli
Tones: 100 ms, 1–48 kHz, 30–80 dB SPL
FM sweeps: logarithmic, 1–40 kHz, (±)25–150 oct.s
White-noise: 100 ms, 80 dB SPL
Natural sounds: 5–10s fragments of animal vocalizations

Neuronal Responses Are Heterogeneous

Population Response Is Lognormally Distributed

Response epochs
Lognormal distribution of firing rates
Lognormal distribution fits better than exponential

Population Response Is Sparse
Small fraction of the population participates in response

Small population fraction shows a well-driven response

Summary
We recorded from 145 neurons in awake rats using cell-attached recordings.
Neuronal responses are heterogeneous; neither spatial nor laminar position predicts response pattern.
Spontaneous and evoked firing rates follow lognormal distribution.
Spontaneous and evoked firing rates are typically low (< 3 sp/s).
The population response is sparse; less than 5% of the population shows well-driven (> 20 sp/s) responses.