Spike trains

Chao Huang

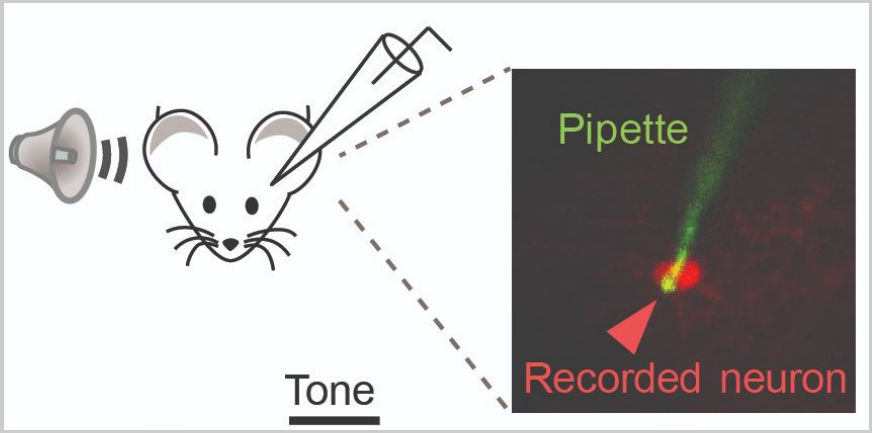
Outline

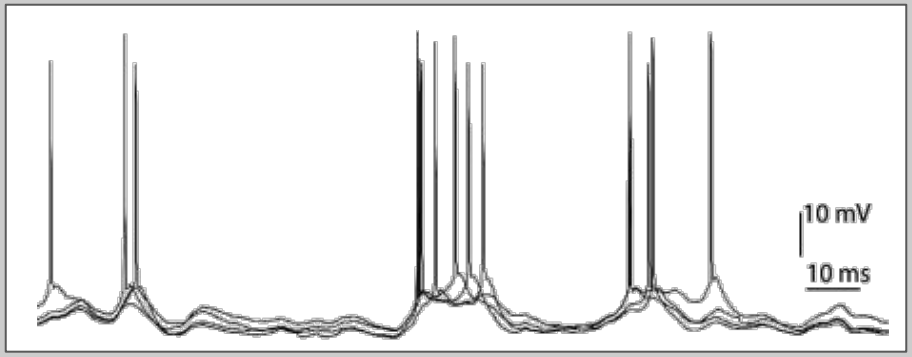
- From voltage recordings to spike trains
- Representing spike trains
  - Raster plot
  - Peri-stimulus histogram (PSTH)
- Neuron tuning curves

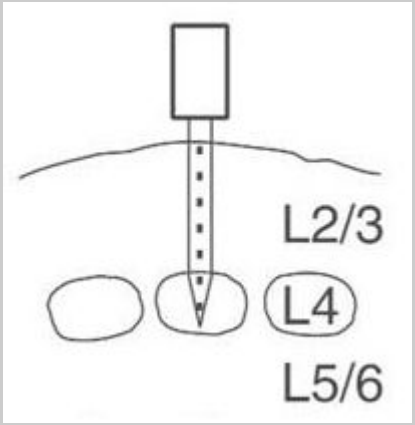
Outline

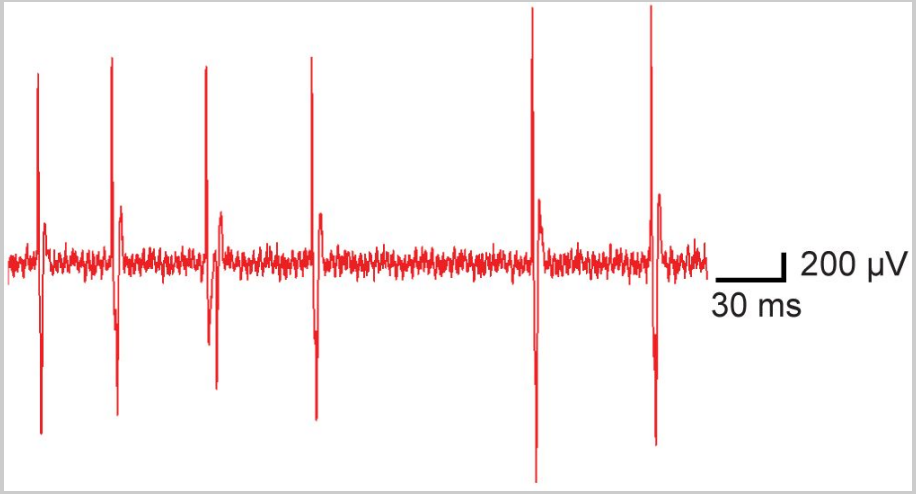
- From recordings to spike trains
- Representing spike trains
  - Raster plot
  - Peri-stimulus histogram (PSTH)
- Neuron tuning curves

Direct recording of spikes

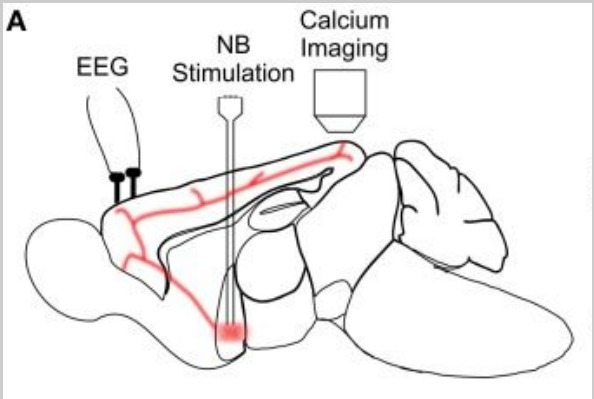




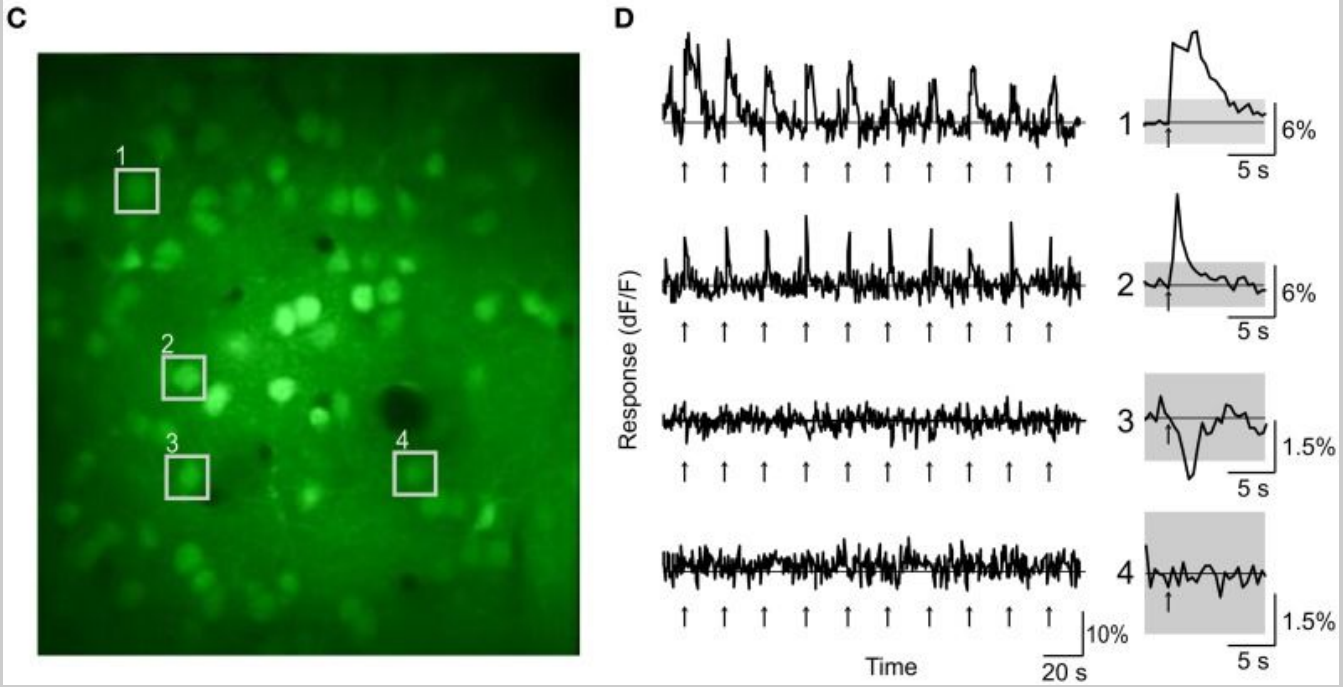




Indirect recording of spikes



Alitto and Dan 2013



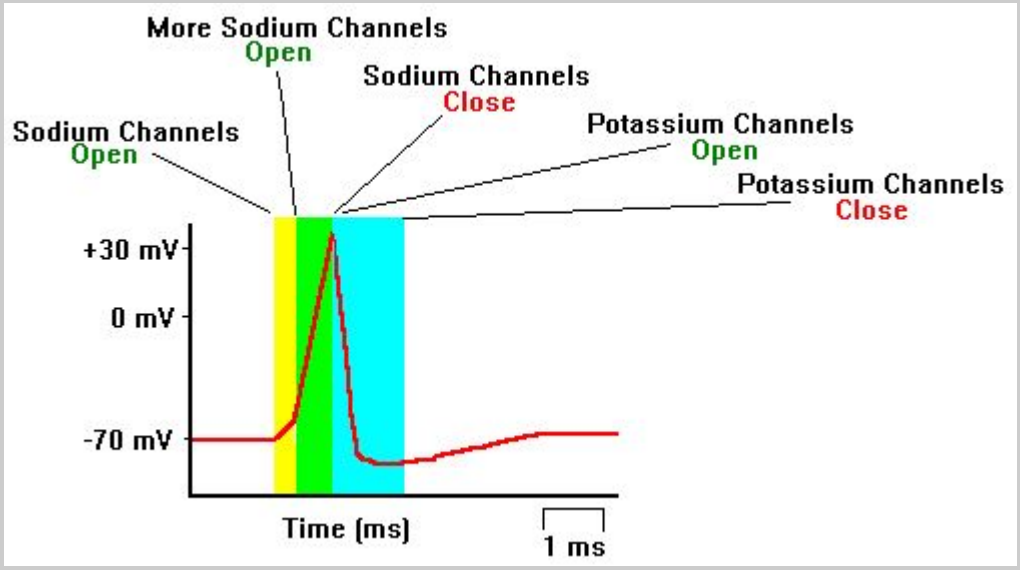
From ‘raw’ signals to spike trains

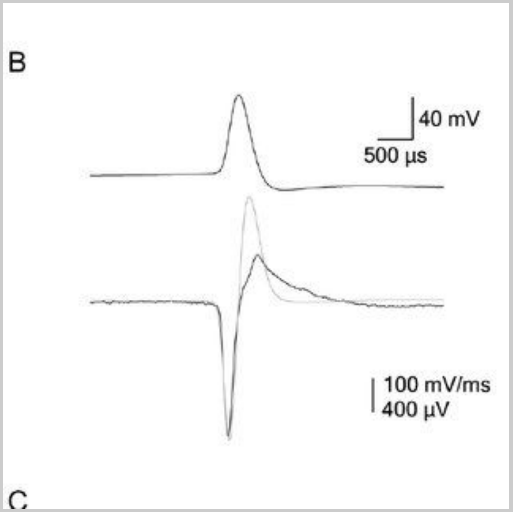
- Neural signals:
  - Analog

- Spike trains:
  - Digital (i.e. only 0s and 1s)
  - 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, ……
  - Or, just spike times: 10.1, 17.5, …… (unit: ms)

From ‘raw’ signals to spike trains

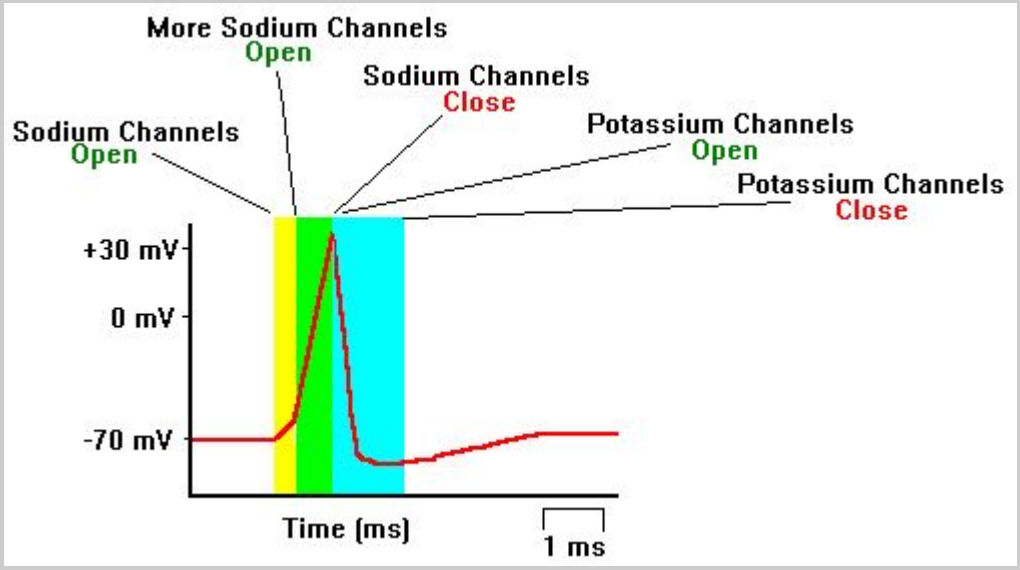
- How to decide spike time?

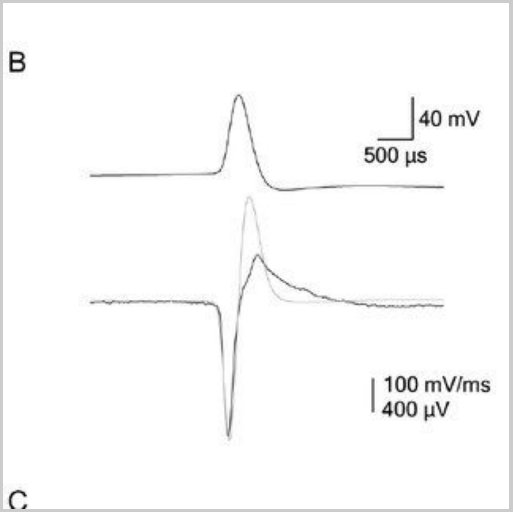




From ‘raw’ signals to spike trains

- How to decide spike time?



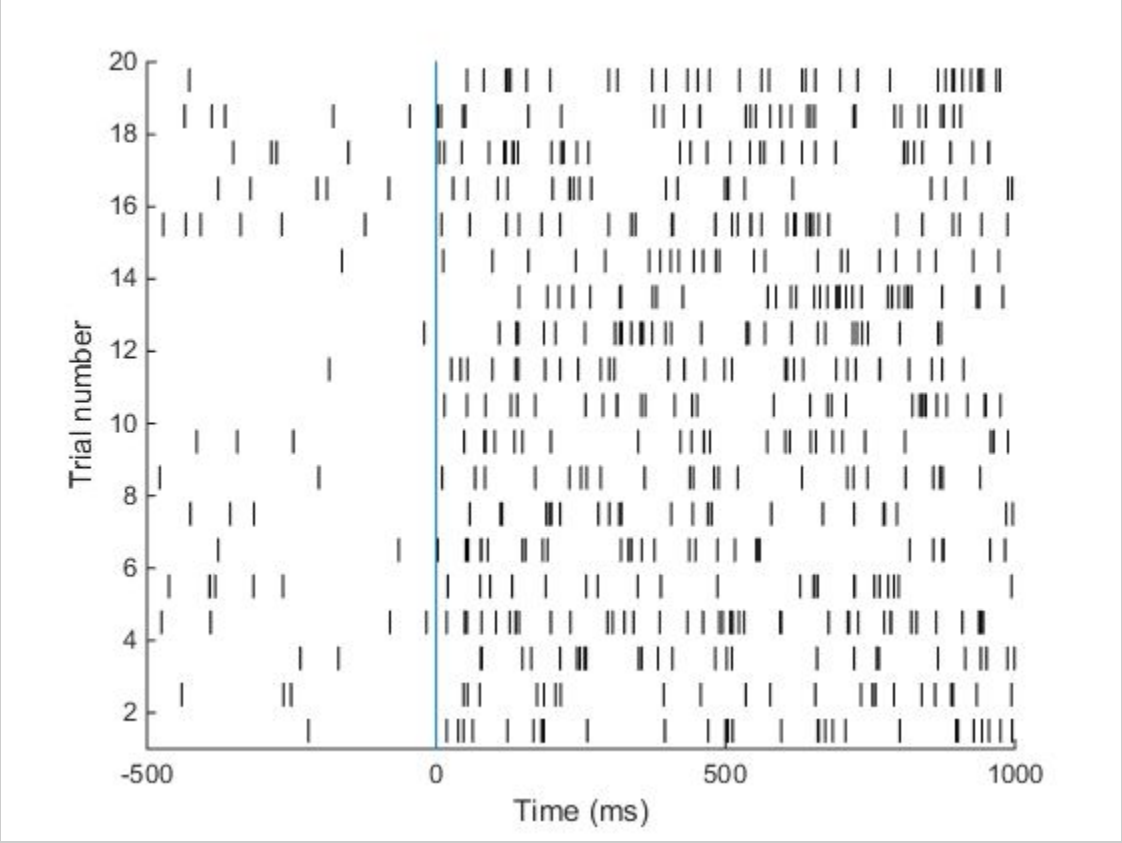


  - Decide a criteria (mostly voltage threshold) and stick to it

Outline

- From recordings to spike trains
- Representing spike trains
  - Raster plot
  - Peri-stimulus histogram (PSTH)
- Neuron tuning curves

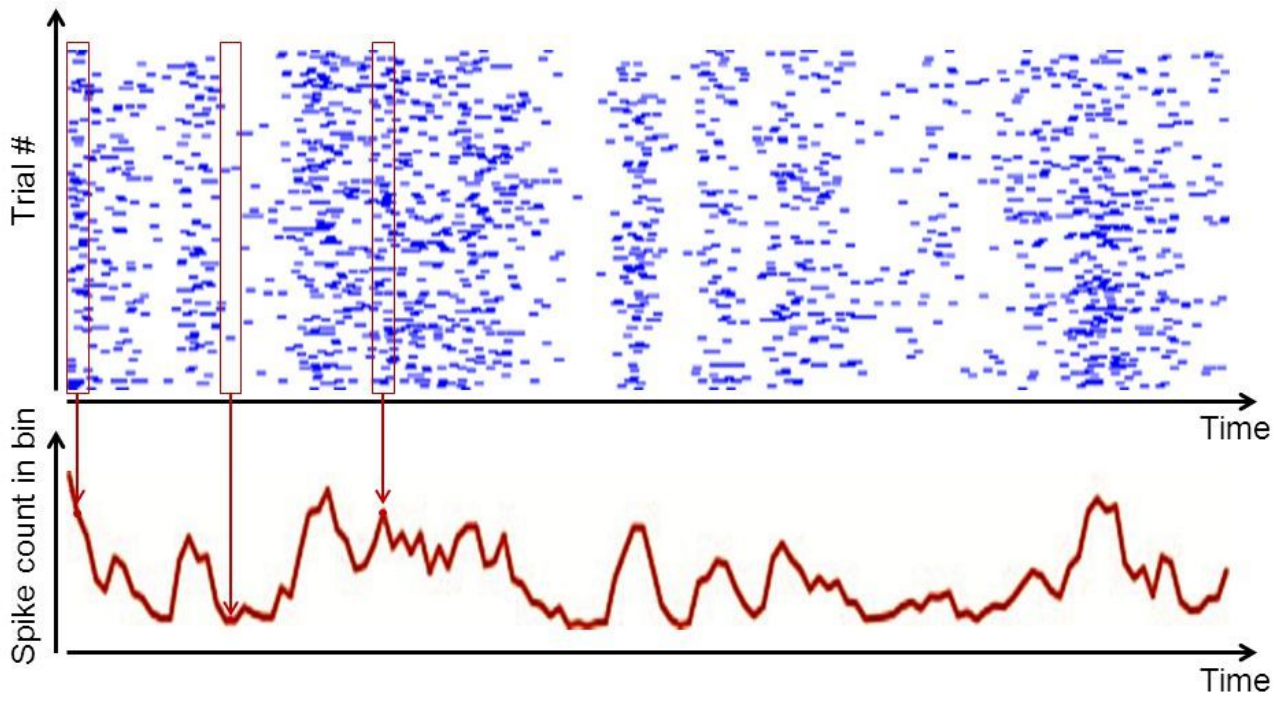
Raster plot



Outline

- From recordings to spike trains
- Representing spike trains
  - Raster plot
  - Peri-stimulus histogram (PSTH)
- Neuron tuning curves

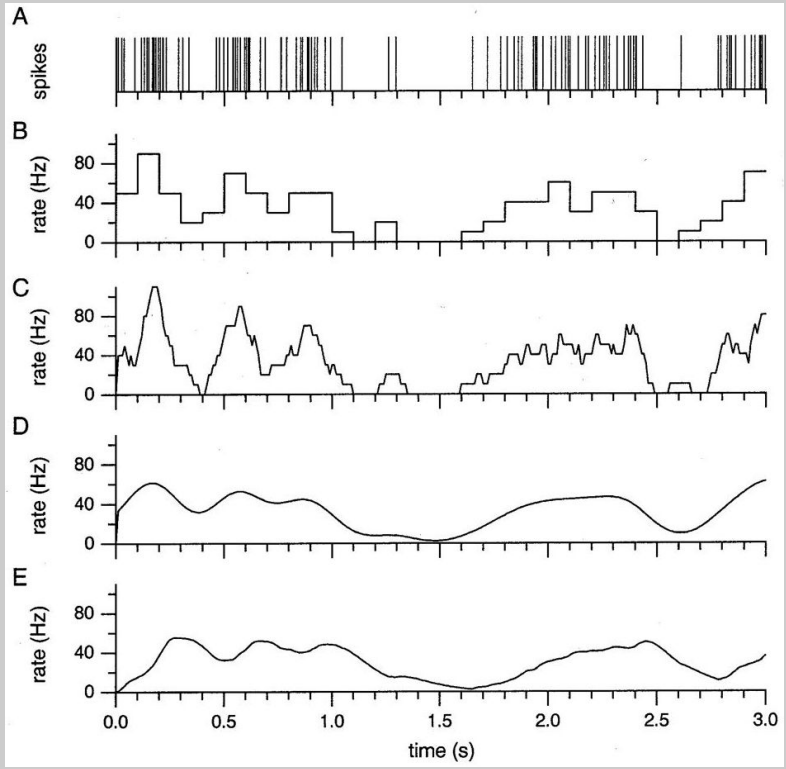
PSTH



Estimated firing rate is $\frac{\#spikes}{bin\ size}$

PSTH

- How much precision do you need?



(P. Dayan, L.F. Abbott, 1999)

  - No fixed answer; choose one which is appropriate

Outline

- From recordings to spike trains
- Representing spike trains
  - Raster plot
  - Peri-stimulus histogram (PSTH)
- Neuron tuning curves

Tuning curve

- Tuning curve: a plot of the average firing rate of the neuron as a function of relevant stimulus parameters