Week 5 – part 1 :Variability

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Neuronal Dynamics:
Computational Neuroscience of Single Neurons

Week 5 – Variability and Noise:
The question of the neural code

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5.1 Variability of spike trains
- experiments

5.2 Sources of Variability?
- Is variability equal to noise?

5.3 Three definitions of Rate code
- Poisson Model

5.4 Stochastic spike arrival
- Membrane potential fluctuations

5.5. Stochastic spike firing
- subthreshold and superthreshold

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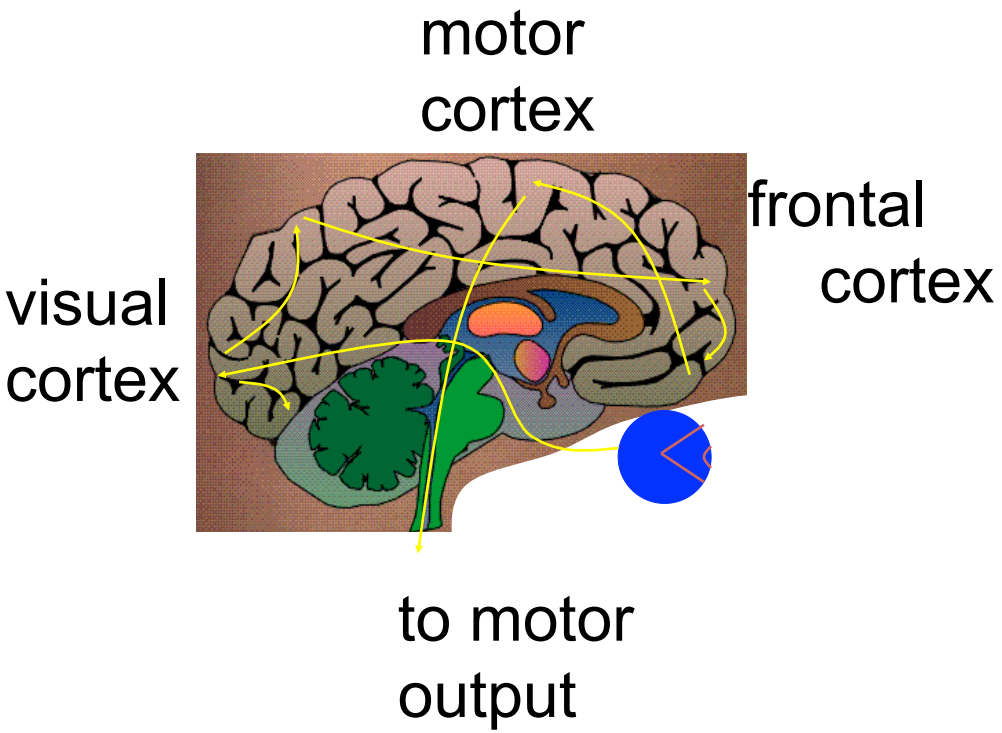
Neuronal Dynamics – 5.1. Variability

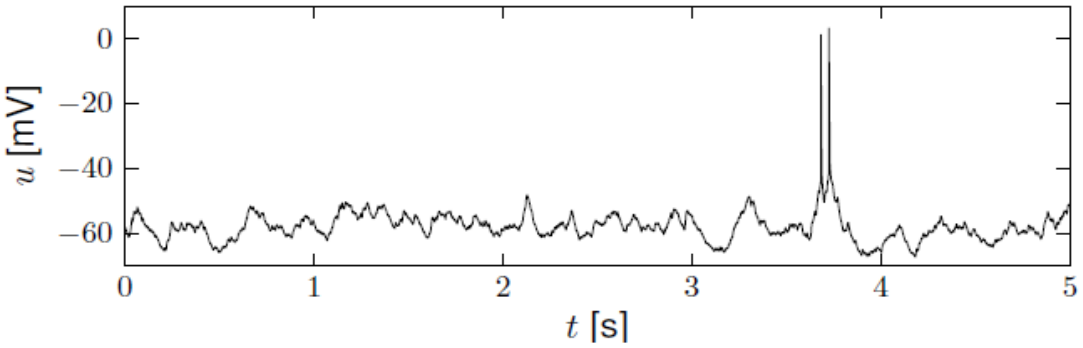


Neuronal Dynamics – 5.1 Variability in vivo

Spontaneous activity *in vivo*

Variability
- of membrane potential?
- of spike timing?

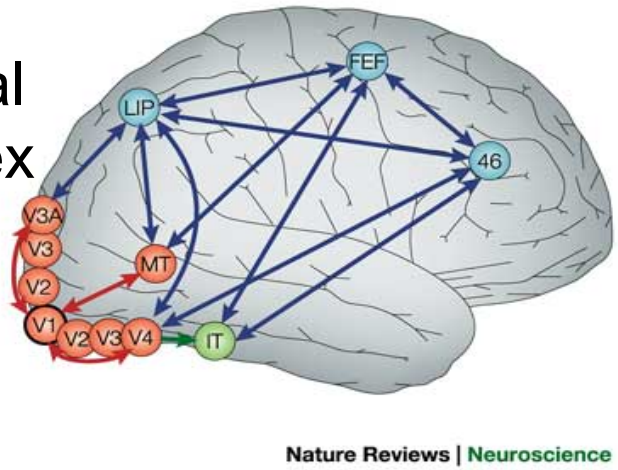
awake mouse, cortex, freely whisking,

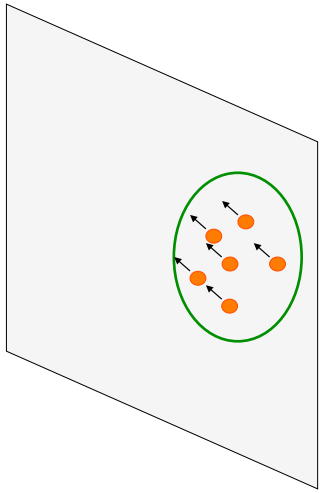


Crochet et al., 2011

Detour: Receptive fields in V5/MT

visual cortex

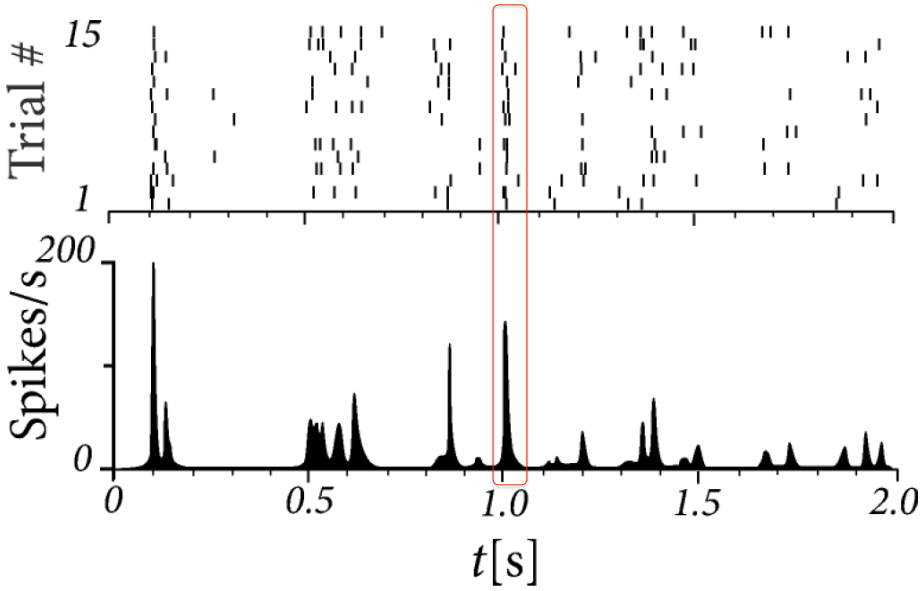


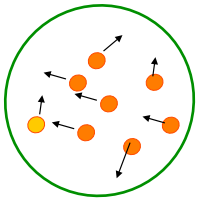


cells in visual cortex MT/V5 respond to motion stimuli

Neuronal Dynamics – 5.1 Variability in vivo

15 repetitions of the **same** random dot motion pattern

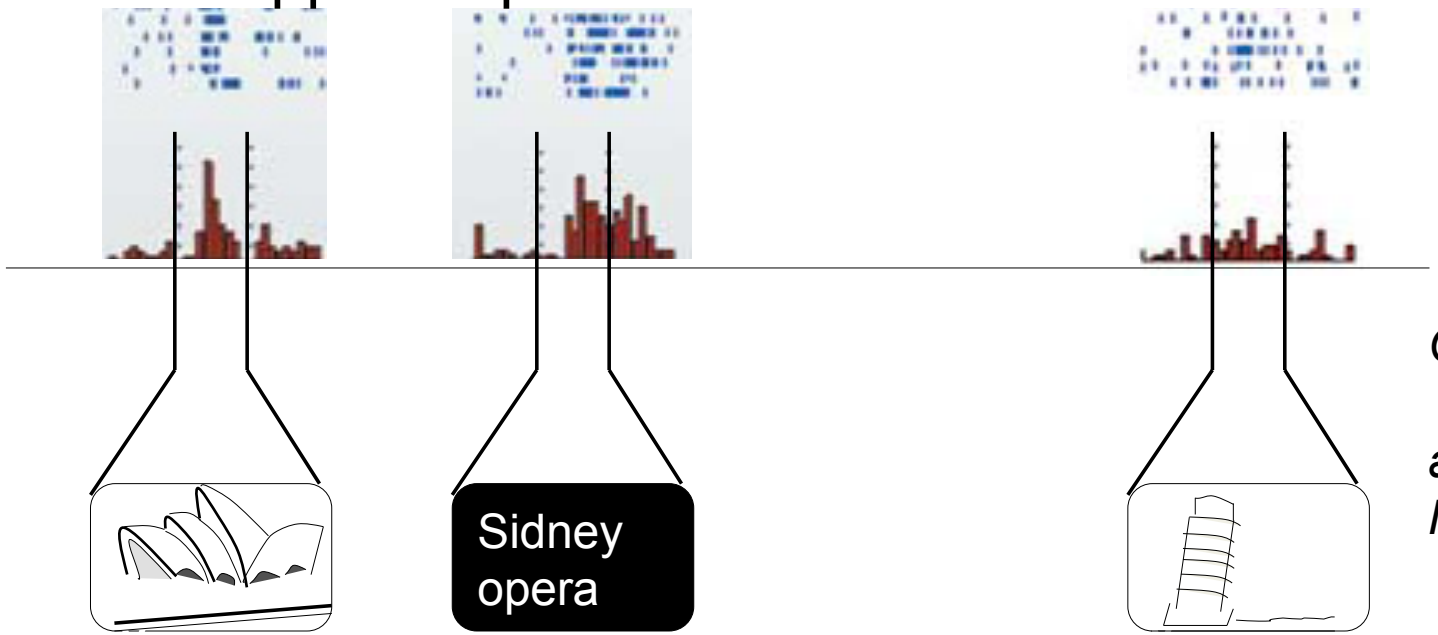




adapted from Bair and Koch 1996;
data from Newsome 1989

Neuronal Dynamics – 5.1 Variability in vivo

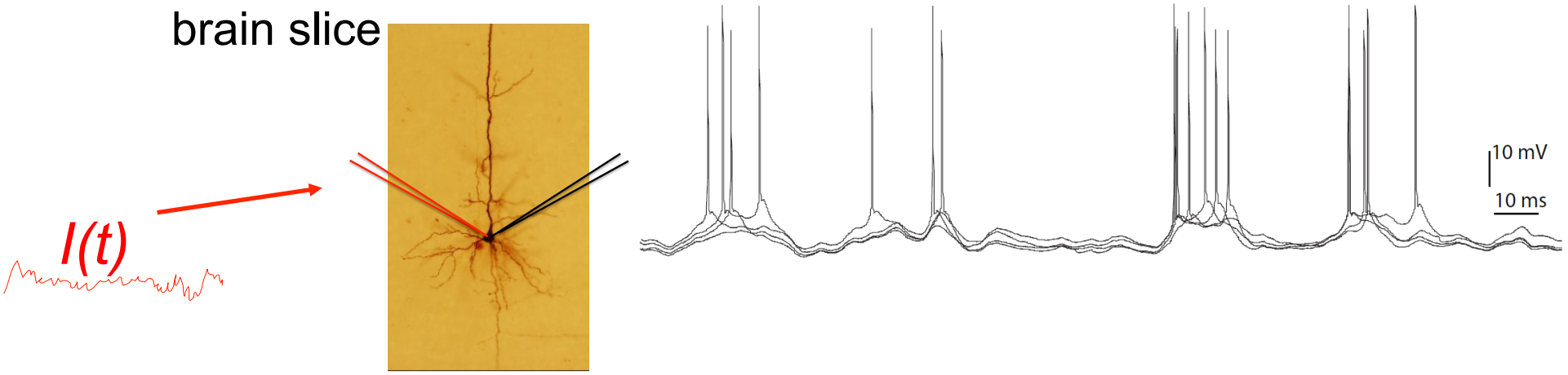
Human Hippocampus



Quiroga, Reddy, Kreiman, Koch, and Fried (2005). Nature, 435:1102-1107.

Neuronal Dynamics – 5.1 Variability in vitro

4 repetitions of the same time-dependent stimulus,



Neuronal Dynamics – 5.1 Variability

Fluctuations

-of membrane potential

-of spike times

fluctuations=noise?

relevance for coding?

source of fluctuations?

model of fluctuations?