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
5.1 Variability of spike trains
   - experiments

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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

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

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?