Review and Preview

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U2IS - ENSTA - IPParis

ecampus moodle: MI210 - Modèles neuro-computationnels de la vision (P4 - 2020-21)

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Plan

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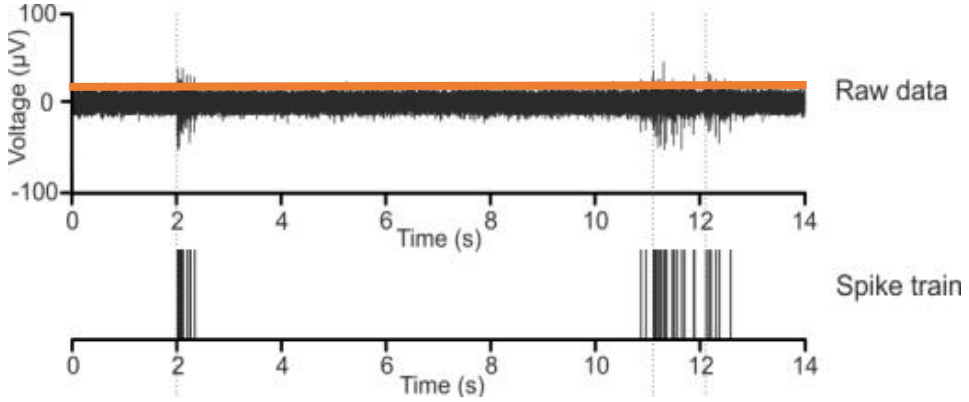
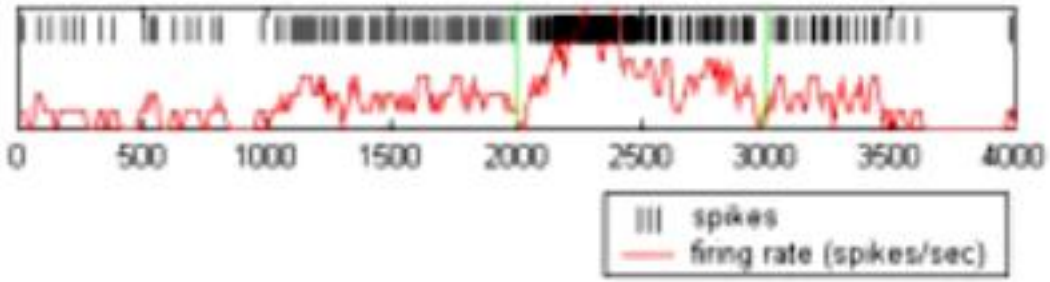
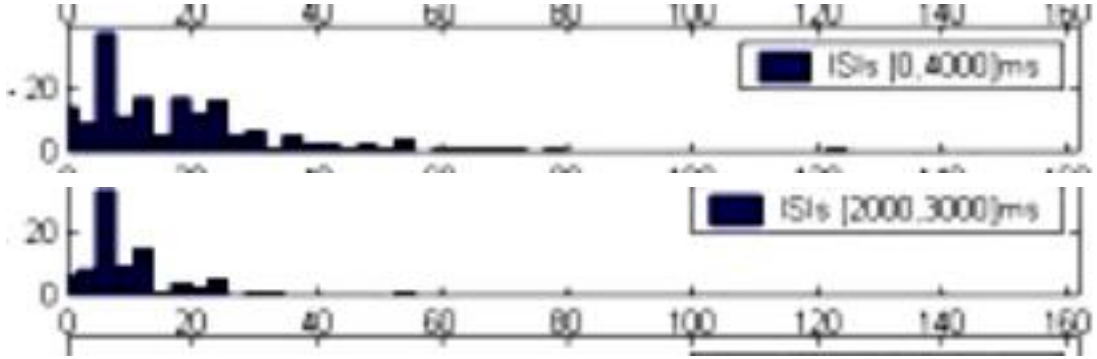
1st Class

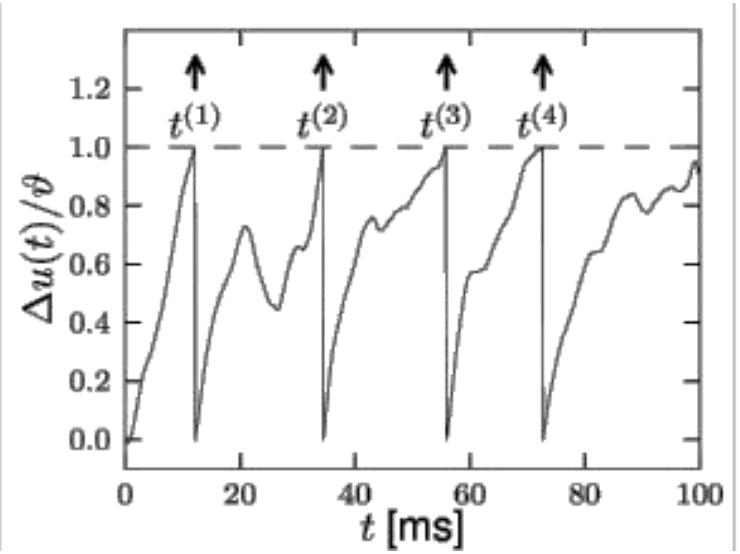

100
0
-100
Voltage (μV)
0
2
4
6
8
10
12
14
Time (s)
Raw data
Spike train
Time (s)

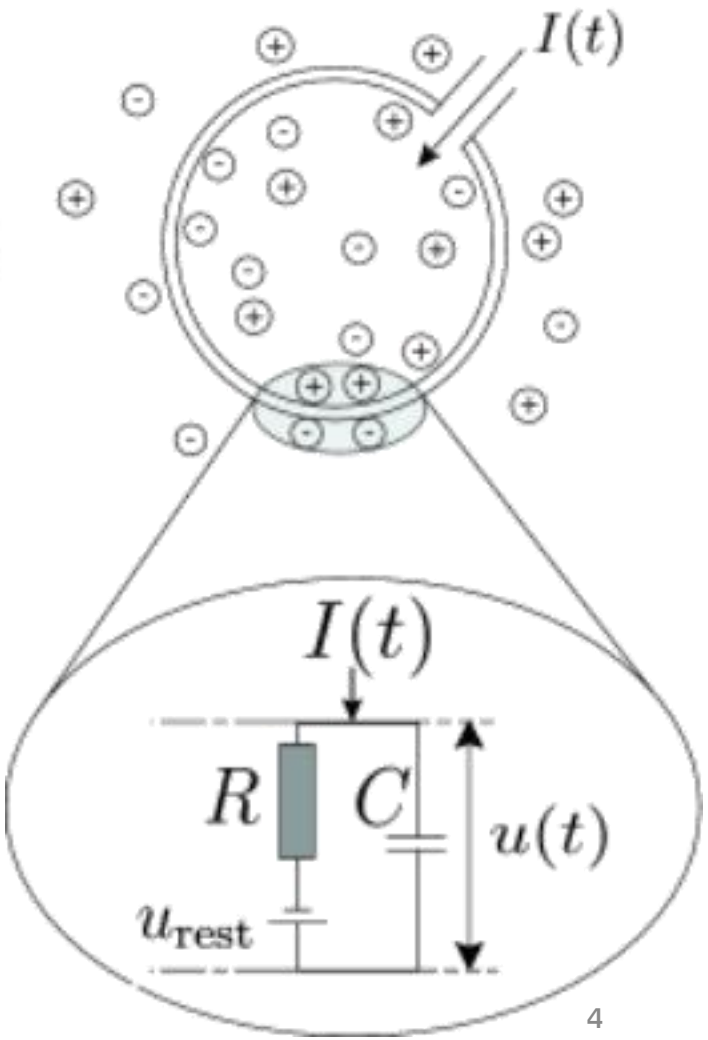

0
500
1000
1500
2000
2500
3000
3500
4000
spikes
firing rate (spikes/sec)


20
0
ISIs [0,4000]ms
20
0
ISIs [2000,3000]ms
0
20
40
60
80
100
120
140
160

1st Class

$$V(t) = \begin{cases} V_{rest} & \text{if } V(t) = v_{th} \\ V_{rest} - \tau \frac{dV}{dt} + RI(t) & \text{o.w.} \end{cases}$$





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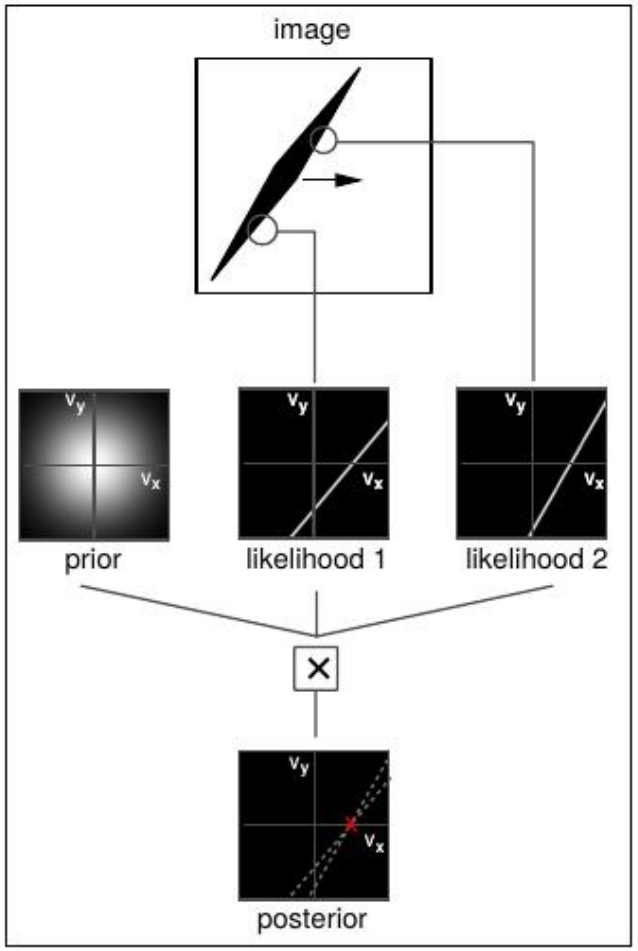
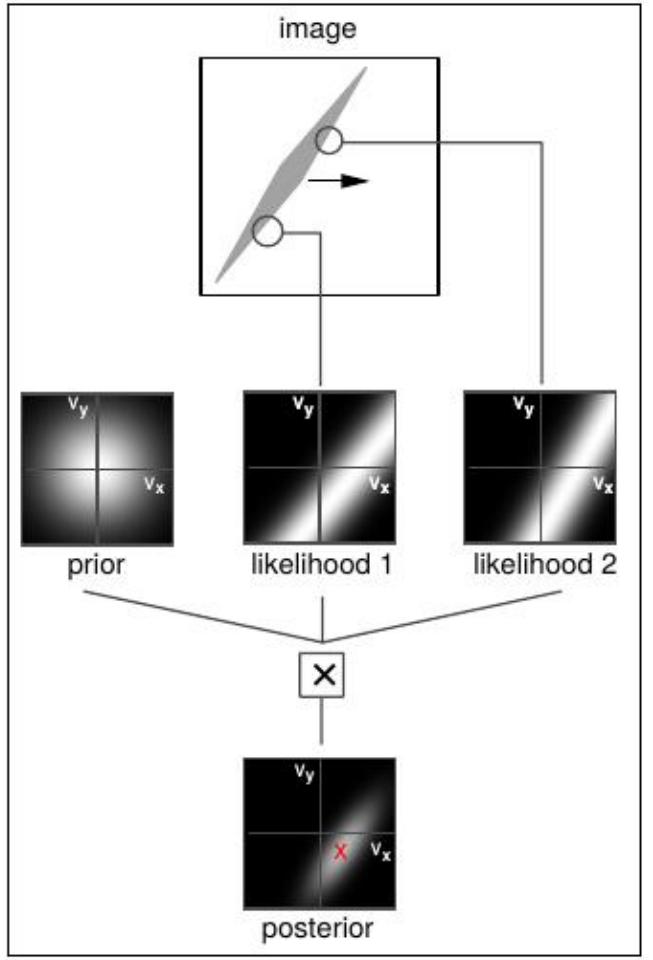
Chapter 2

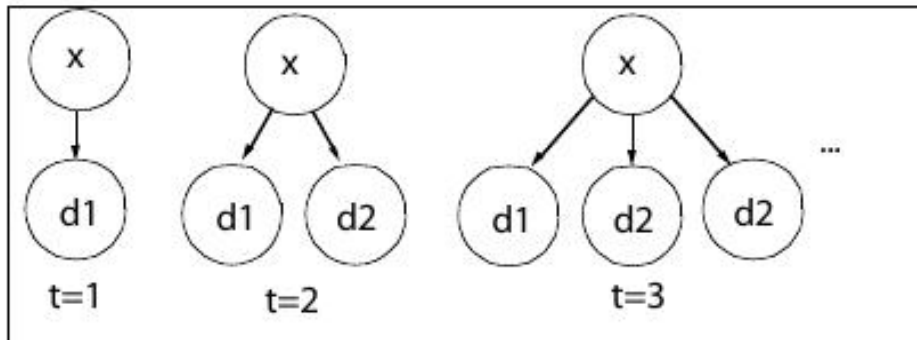




Weiss et al, 2002

Chapter 2

1. The generative model
2. **The inference process**
3. The distribution of the MAP estimate



$$p(x \mid d_1 \cdots d_N) \propto p(x) \prod_{i=1}^{N} p(d_i \mid x)$$

$$= p(x) p(d_N \mid x) \prod_{i=1}^{N-1} p(d_i \mid x) \propto p(x \mid d_1 \cdots d_{N-1}) p(d_N \mid x)$$

The posterior at time N-1 is the prior at time N

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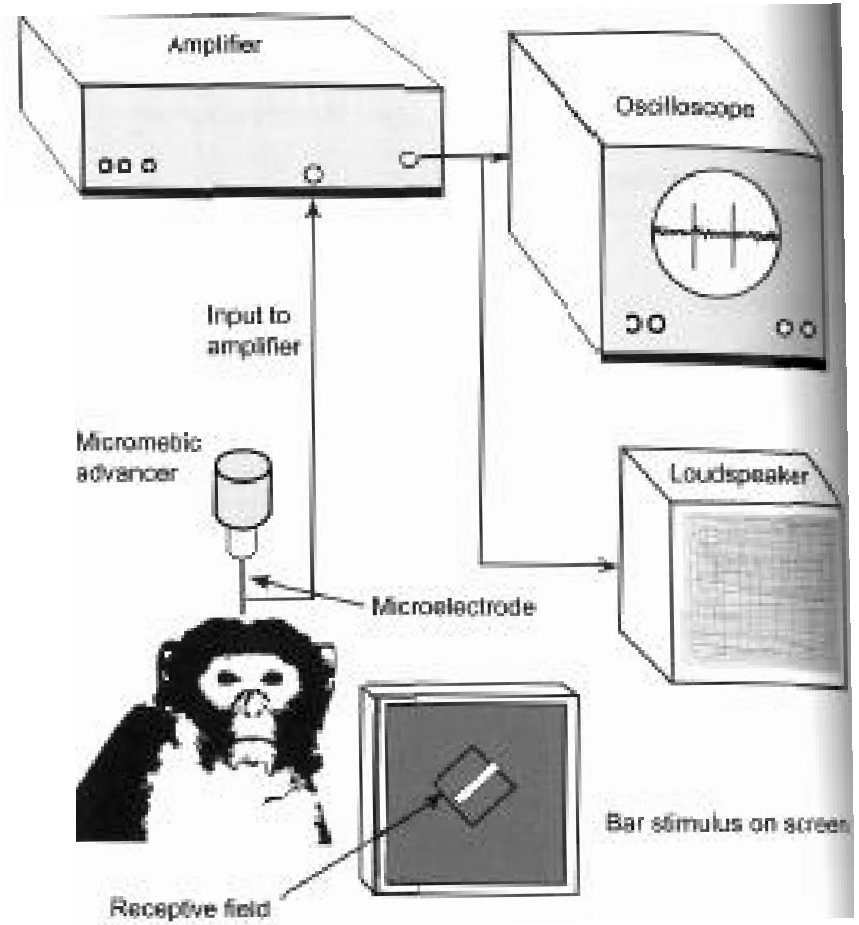
Neural Recordings

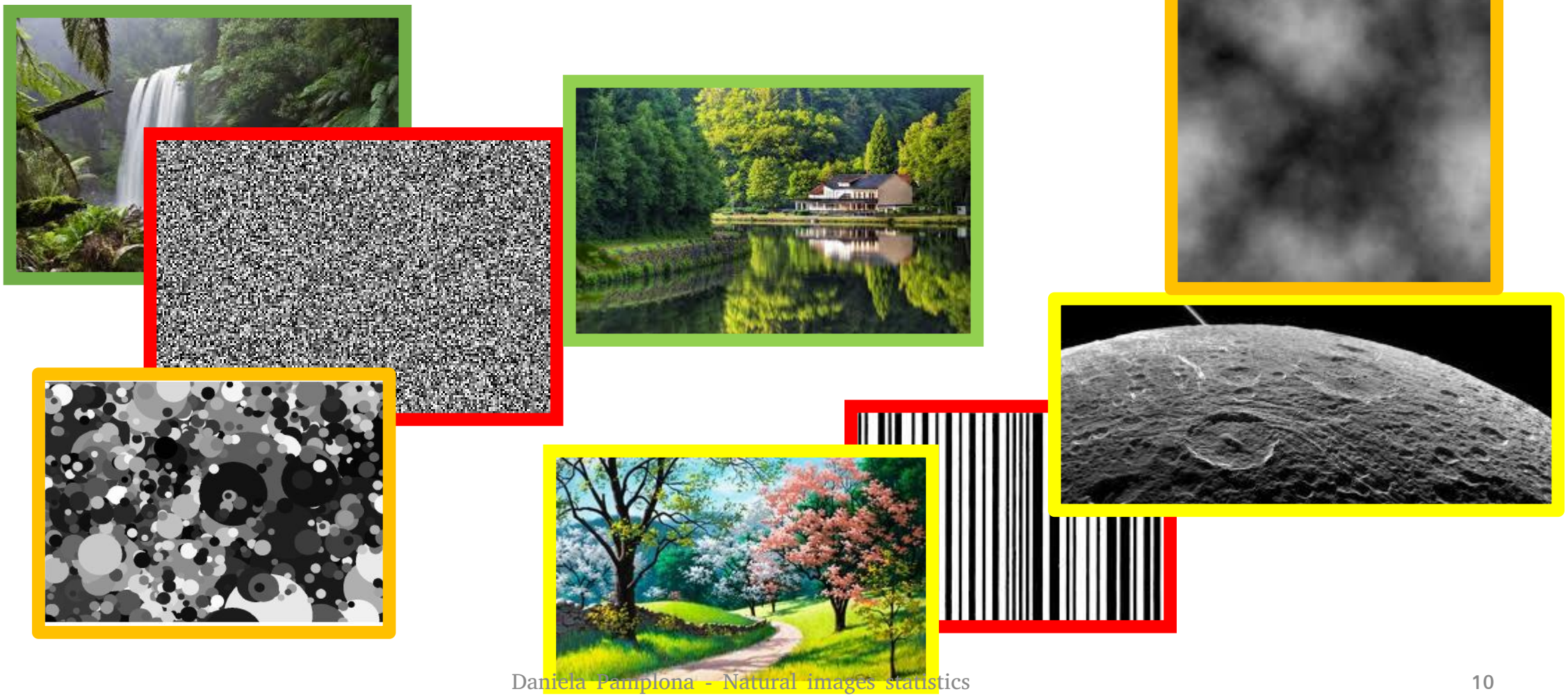


3.5 Single cell recording
The primate looks alert in the picture, and indeed fully conscious animals are sometimes used (the brain has no pain receptors). However, the animal is usually anaesthetized to achieve complete immobilization. This helps control accurately where the eyes are looking

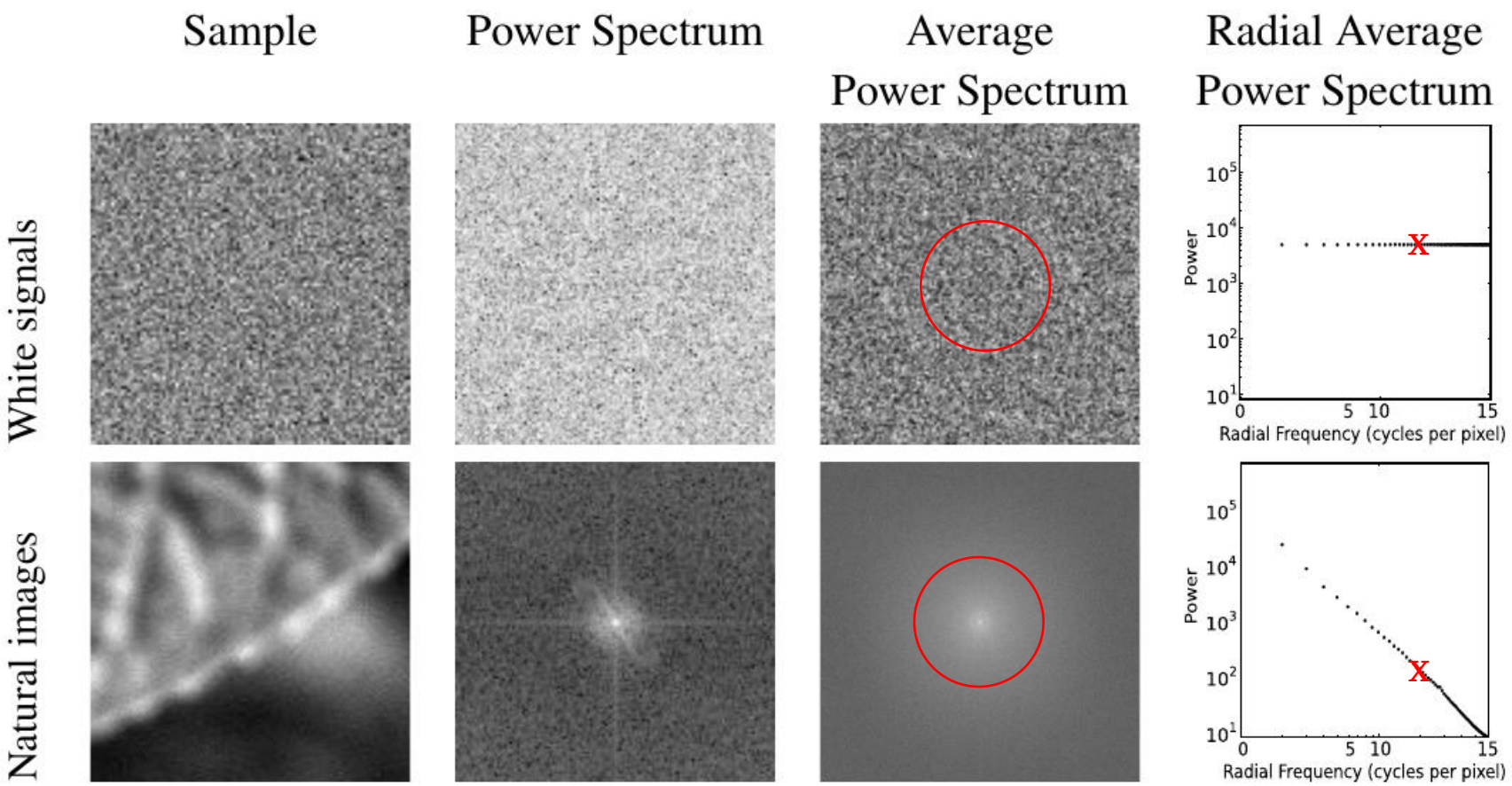
Seeing: The compuational Approach to Biological Vision

What is the message?
What are natural images?

Non Natural — Natural

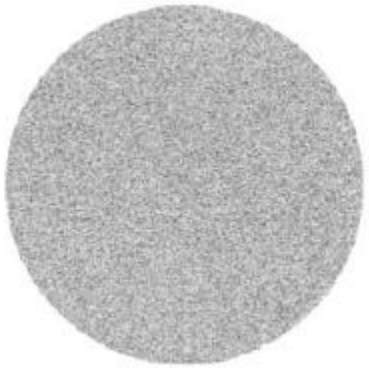


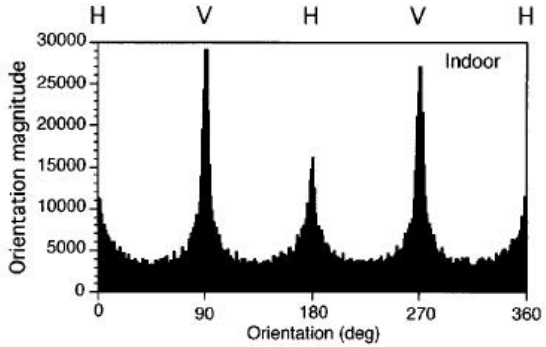
Power Spectrum of Natural Images

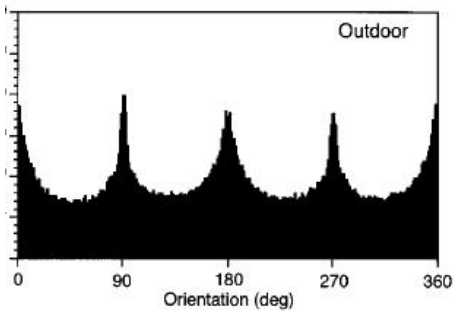


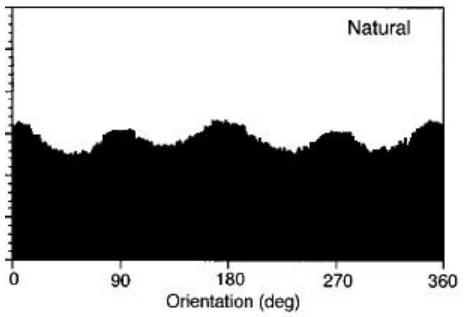
Analysis of edges orientations

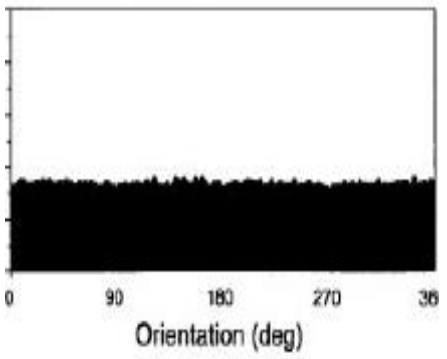
Indoor | Outdoor | Natural | White Noise











The distribution of oriented contoursin the real world, Coppola et al

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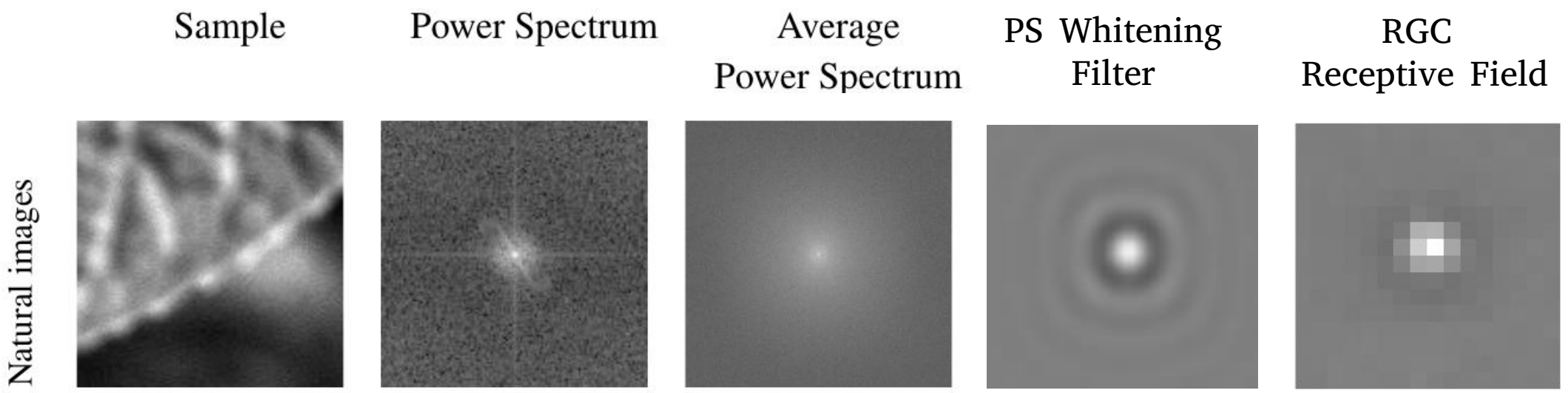
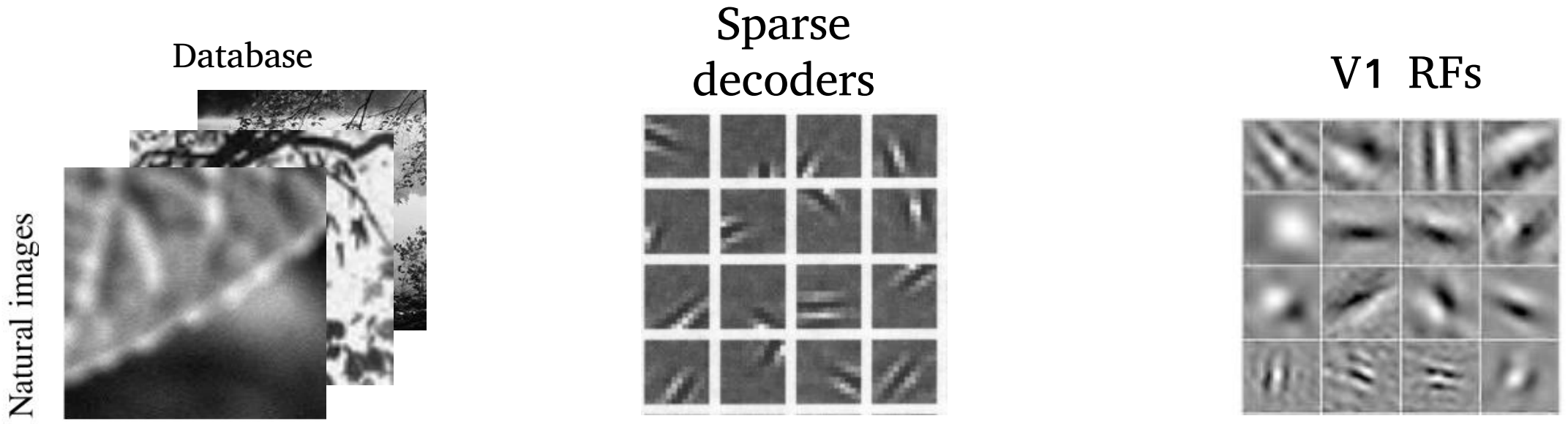
Whitening filters of natural images



RGCs RFs have shape like whitening filters of natural images!

Sparse overcomplete code of natural images



The receptive fields of V1 simple cells have such shape that they represent efficiently the natural images!

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How is it going?

Questions?

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Contents

1. Major types of eye movements
2. What triggers saccades?
3. Reinforcement learning
    1. Markov decision processes
    2. Q learning with Monte Carlo and SARSA
4. Eye movements to learn to solve visually guided multi-tasks