Mapping the primate LGN

Presented by Edward and Ning
Introduction
Pathways

Magnocellular
achromatic, movement

Parvocellular
color opponent, details

Koniocellular
blue on/off

Fig. 26. Histological section through the primate lateral geniculate nucleus (LGN) to show the layering of the neurons into 4 parvocellular layers, 2 magnocellular layers and 6 koniocellular layers.
M-cells: large CRF
P-cells: small CRF
K-cells: blue on-off CRF
ECRFs in detail

- Not much is definitively known about the extra-classical receptive field.
- Possibly suppresses the CRF when stimulated (extra-classical inhibition [ECI])
- ECI is dependent on the contrast presented to ECRF
- Asymmetric fields, possibly due to different inputs compared to the CRF.
- ECI may originate from the retina
- Anesthesia affects the cortex, which may influence extra-classical suppression.
- ECI may help with contrast-dependent aperture tuning, allowing for improved spatial precision.
Natural stimuli and LGN response

- In studies done to define primate CRFS and ECRFs, the questions left are whether RF properties change when more naturalistic stimuli are done.
- Classical method studying the response of cat LGN neurons to natural scene, Stanley et al. (1999).
  - mapped the CRF of 177 cells using white noise stimuli.
  - recorded the neural response to three different natural scene movies
  - performed a video reconstruction by convolving the computed CRFs with the spike chains which correspond to the natural stimuli.
  - demonstrated that the RFs from white noise stimuli were at least similar to those expected from natural scenes.
- Following works done by Lesia and Stanley (2004) examined the difference in tonic and burst spiking in response to nature scene
  - They investigated that there was more bursting in response to the natural scene movies than to the white noise.
  - More robust LGN responses to the natural scene indicate that white noise may not be desirable as mapping RFs.
Talebi and Baker compared the predictive robustness of RFs generated from artificial and natural stimuli.
- Recorded neuronal responses to white noise, short bars, and natural images.
- Natural image based models performed better in cross-type validation than models from the two artificial stimuli.
- This suggested that artificial stimuli may be poor probes for RF mapping which supports the results of Stanley

More research work about natural scenes has been done by other people, e.g. Tan, Yao and Mante. For more information, the author refers to Simoncelli and Olshausen(2001) reviews.
The standard mapping paradigm displays mapping stimuli while neural signals are recorded.

- A set of black-and-white random checkerboards represent a series of mapping stimulus as the neural response is recorded.
Frames where a spike is detected are highlighted with gray box label with lower case letter.
Labeled frames are collected and averaged to form a map.
Parallel processing strategies of the primate visual system