Computation in Neural Systems: Biological Vision

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www.ini.unizh.ch/~kiper/comp_vis/index.html
Newton’s experiment

Wandell, 1998, plate 4.1
Real life color perception

Illumination

Reflectance

Cone sensitivities

Cone absorptions

Color signal
Cones are of three types: L, M, S. They support color vision.
non color blind

protanope (red cone cells defective)

deuteranope (green cone cells defective)

tritanope (blue cone cells defective)

Scene Viewed by Protanope

Same Scene Viewed by Normal Trichromat
Fig. 21 shows an adaptive optics view of the mosaic of L (red), M (green) and S (blue) cones in four human subjects with normal color vision. The ratio of S to L and M cones is constant but that of L to M cones varies from 1:2.7 (M:L) to 16.5:1 (L:M). (adapted from Williams).
Color matching experiments

Wandell, 1998, plate 4.10
Color matching: results
Color matching: predictions vs. data

Relative primary intensity vs. Wavelength (nm)

- $\overline{r}_{10}(\lambda)$
- $\overline{g}_{10}(\lambda)$
- $\overline{b}_{10}(\lambda)$
Two metameric spectral distributions

(A) 

(B) 

Wandell, 1998, plate 4.11
Receptive fields of LGN neurones

A M cells

On-center

Off-center

B P cells

On-center

Off-center

R^+  G^-
G^+  R^-
R^-  G^+
G^-  R^+
B^+  Y^-
Y^+  B^-
The “DKL” color space

Preferred color of pLGN neurones

Single Unit Recordings (LGN)
The world seen through the LGN
Color contrasts of natural objects

- M only
- L only
- L - M

M-cone contrast vs L-cone contrast graph
Preferred color of pLGN neurones

Single Unit Recordings (LGN)
Preferred color of cortical cells

Single Unit Recordings (V2, V3)
Examples of cortical cells’ responses to color variations

[A] V1

[B] V2

[C] V2

[D] V3

Response (imp/s) vs. Azimuth (deg)
Three stages of color processing