Effects of image statistics on stereo coding in human vision Keith May¹, Li Zhaoping¹ & Paul Hibbard²

¹UCL Department of Computer Science ²School of Psychology, University of St Andrews



• We selectively adapted the S₊ or S₋ channel (analogous to adaptation of spatial frequency channels), and examined the effect on the channel gains

 \mathcal{O}_{\perp}

 $\cos(Y-T)$

horizontal grating

drifting upwards

 $\boldsymbol{\mathcal{O}}$

 $\cos(Y+T)$

horizontal grating

drifting downwards

 $Y = 2\pi f y \qquad T = 2\pi g t$

 3 mins of adaptation before each session, and 9 secs of top-up adaptation between trials (each stereo pair presented for 1.5 secs)

Testing gains on binocular channels

• Relative gains on binocular channels assessed from motion direction judgments for a dichoptic display in which the S_{\perp} signal contained motion in the opposite direction to the S_ signal (Shadlen & Carney, 1986)

sin*Y*sin*T*

counterphase grating

 S_{left}

sinYsinT

counterphase grating



Time



- Stimulus parameterized by ρ , the ratio of S_{+} signal contrast to contrast of monocular motion component (ρ = ∞ givies original Shadlen-Carney stimulus)
- S_{+} signal does not vary with ρ
- Strength of g_{\perp} relative to g_{\perp} indicated by proportion of times motion judged to be in S_+ direction
- Test stimulus was 6 Hz, 1/6 sec
- Two test spatial frequencies: 1 c/deg and 4 c/deg



Results Anticorrelated Correlated 2 4 8 16 ∞ 2 4 8 16 ∞ 2 4 8 16 ∞ 2 4 8 16 ∞ 2 4 8 16 ∞ 2 4 8 16

- Summation (g_{+}) generally stronger for anticorrelated adaptation
- Difference between adaptation type decreases with decreasing adaptation contrast
- Contrast of convergence point scales with test spatial frequency, as expected from 1/f spectrum (1 c/deg content is 4 times contrast of 4 c/deg content)

Predictions of inverted-U gain function





· Predicts more summation with correlated adaptation

Predictions of whitening-only gain function



Adaptation contrast

- Predicts more summation with anticorrelated adaptation
- Predicts data should converge as adaptation contrast decreases

Conclusions

- Cortex adapts to interocular correlations by adjusting the gains on the S_{+} and S_{-} channels to optimize coding efficiency
- Gain control mechanisms in these channels suppress strong signals (whitening), but not very weak ones
- Unlike in the retina, cortical gain control may not need to suppress weak signals because these will be below threshold

References

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