Estimating 2nd-Order Filter Bandwidth in Spatial Frequency and Orientation with Critical-Band Masking

Jerad A. Fields, Christopher A. Henry, Michael S. Landy
Dept. of Psychology & Center for Neural Science, NYU

INTRODUCTION

The tuning properties of spatial filters in the early visual system have been measured using adaptation, summation, and masking. We used critical-band masking to measure the spatial frequency and orientation tuning of 2nd-order channels.

METHODS

CRITICAL-BAND MASKING

The curve represents the power gain of an observer’s hypothetical channel in either the orientation or spatial-frequency domain.

The shaded areas represent noise masks with different cutoffs.

The derivative of the resulting threshold elevation yields an estimate of the channel’s power gain.

STIMULUS CONSTRUCTION

Standard Filter-Rectify-Filter model of 2nd-order texture perception.

NOISE MASKS

Experiment 1: Spatial frequency

bandwidth increases across conditions:

Task: Vertical/horizontal discrimination

Experiment 2: Orientation

bandwidth increases across conditions:

Task: Vertical modulation detection

RESULTS

Spatial Frequency Masking

Orientation Masking

CONCLUSION

- Critical-band masking is effective for 2nd-order channel characterization.
- Estimated 2nd-order orientation tuning is broad relative to 1st-order channels, while 2nd-order SF tuning is relatively narrow.