An object-oriented brightness model - application to brightness illusions

However, with increasing retinal eccentricity from the central fovea to about 2 deg, the image quality remains apparently unchanged, while cone spacing increases by a factor of two. Simple calculations with data from optics and cone spacing clearly show the potential presence of severe aliasing in the peripheral fovea. To understand this disagreement, a systematic study of the effect of aliasing-limiting factors on foveal sampling has been carried out. Optical image quality, cone aperture, irregularities of the mosaic, intercone coupling and waveguide effects have been taken into account in computations of aliasing-error parameters from 0 to 2 deg of retinal eccentricity. Computer-simulated foveal post-sampling images of simple test objects (sinusoidal gratings, typical acuity and hyperacuity test) have also obtained with consideration of these eccentricity-variant limiting factors. Preliminary results show that the initially possible foveal aliasing becomes of very limited importance when some of these factors are included in the computations.

◆ **An object-oriented brightness model—application to brightness illusions**
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An object-oriented model for the brightness perception of static images is presented. The philosophy behind the model is that the visual system aims at a brightness representation that displays object properties, and consequently is insensitive to variations in light source and viewing conditions. The model assumes an ensemble of neural units that differ in receptive field size, ie identical operations are performed at a number of spatial scales. The operating characteristics reflect the behaviour of typical cells in the visual pathway, such as ganglion cells, and are robust against variations in light level. The brightness at each retinal position is the weighted sum of neural activities that exist at this position in the different scales. The weighting function is such that the brightness impression is robust against variation in viewing distance.

Some 2-D model predictions on brightness illusions are presented. It is shown that the appearance of brightness illusions, such as Hering grids, Mach bands, and illusory effects concerning brightness induction and brightness assimilation, can be explained by the object-oriented brightness model.

◆ **Human vision combines oriented filters to compute edges**
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I offer a new model for 2-D feature extraction in human vision, based upon the perceived spatial structure of plaid patterns. The plaids were formed from the sum of two or three sinusoidal gratings at different orientations. Judgments of structure were consistent with edge localization at zero-crossings in the output of a circular spatial filter of 1 - 1.5 octaves bandwidth. However, orientation-selective masking and adaptation effects clearly favoured a model in which oriented filter outputs were first linearly combined, and then zero-crossings extracted. The combining of filters is context-sensitive, not hard wired. For example two sine-waves of the same frequency at $\pm 45°$ looked like a blurred chessboard with vertical and horizontal edges, but adding a weak third harmonic caused a categorical shift to the perception of oblique edges. In the first case different orientation components are perceptually combined, in the second they are not. An orientation-selective parsing rule may group filter outputs before zero-crossing detection, allowing overlapping features to be segmented. Grouping of filters by common orientation and phase has priority over other groupings. The combined filter is characterized by two new techniques, and is not a 2nd-derivative filter.