A General, Mechanistic Model of Spatial Pattern Detection

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Abstract

Purpose: We propose a general, mechanistic, image-processing model of human spatial pattern detection.

Methods: The model consists of three parts: a retinal component, a cortical component, and a detection mechanism. The retinal stage involves luminance normalization (dividing by the local mean luminance and then subtracting the new local average) followed by a static nonlinearity similar to Graham and Hood (Vis. Res. 32:1373-1393, 1992). In the cortical stage, quadrature phase linear filter outputs are squared and summed to yield local frequency and orientation energy responses which are then divisively normalized (Heeger, Vis. Neurosci. 9:427-443, 1992). Finally, detection is mediated by an ideal observer rule.

Results: The model accounts for a large body of data including: (1) luminance masking (Kortum & Geisler, Vis. Res., in press), (2) contrast sensitivity for different mean luminances and grating areas (Rovamo et al, Vis. Res. 34:1301-1314, 1994; Van Nes & Bouman, J. Opt. Soc. Am. 57, 1967), (3) spatial masking as a function of masker orientation (Foley, J. Opt. Soc. Am. A. 11:1710-1719, 1994; Bradley & Ohzawa, Vis. Res. 26:991-997, 1986) and masker phase (Foley & Boynton, Proc. SPIE 2054, 1994) and (4) subthreshold summation experiments (Graham, 1989).

Conclusions: Such a mechanistic, image-processing model of human spatial pattern detection is useful because it predicts the results of any spatial pattern detection experiment. Moreover, it can also be used as a measure of image integrity in designing and evaluating image processing algorithms.

Slide set of talk presented at ARVO '95.

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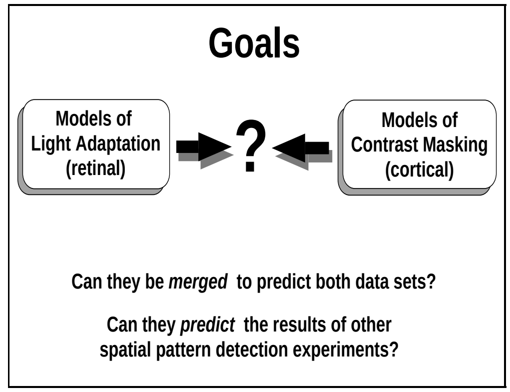

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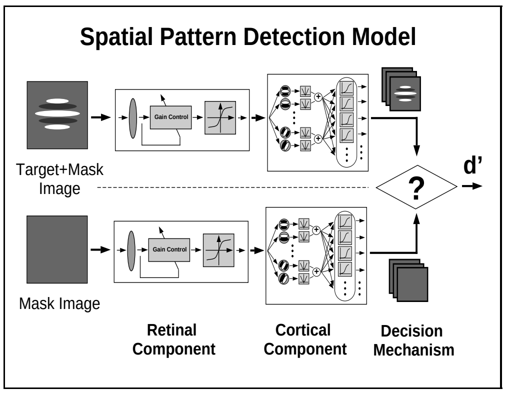

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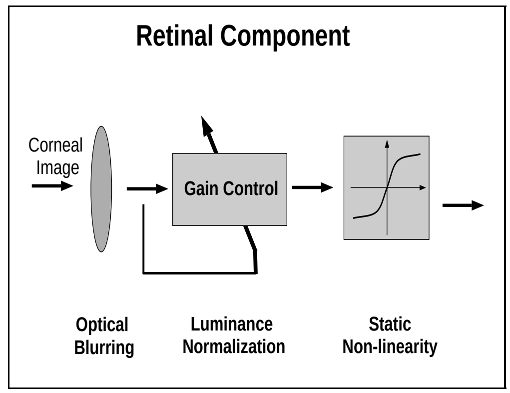

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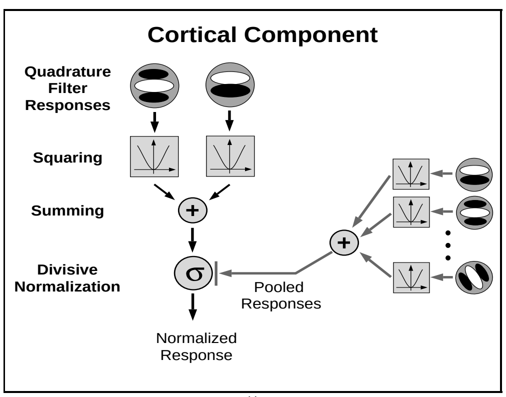

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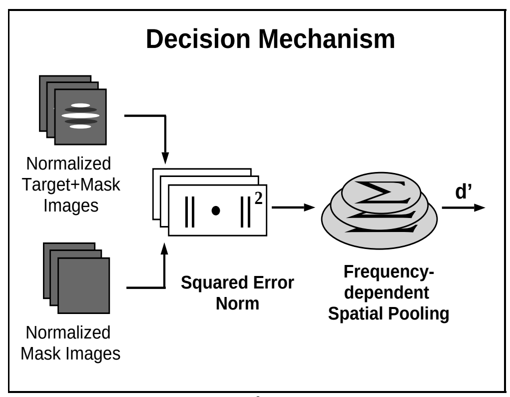

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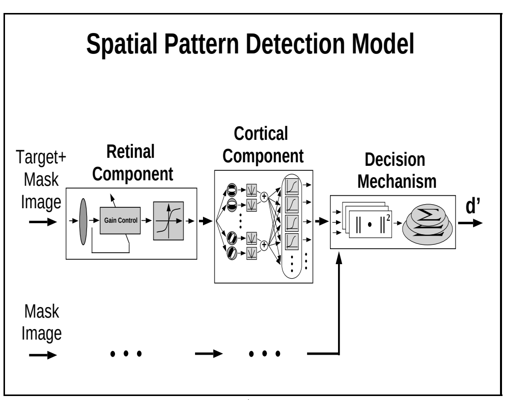

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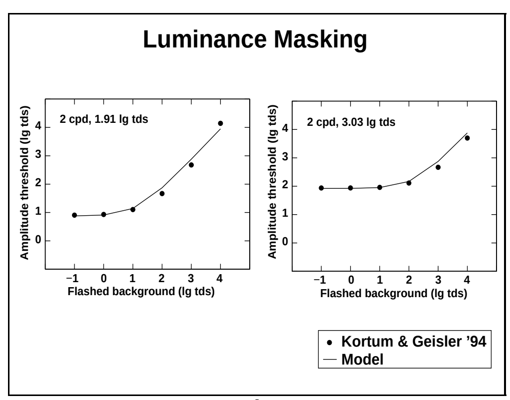

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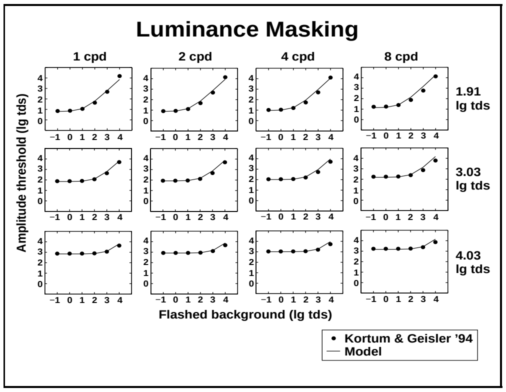

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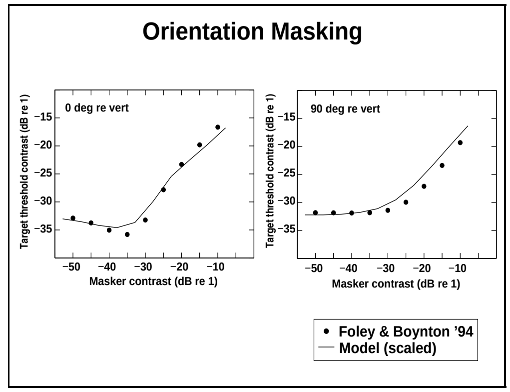

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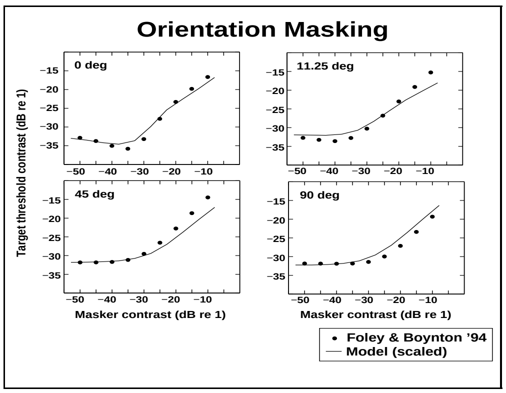

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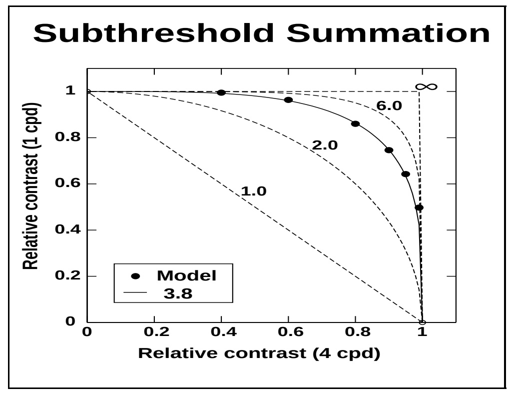

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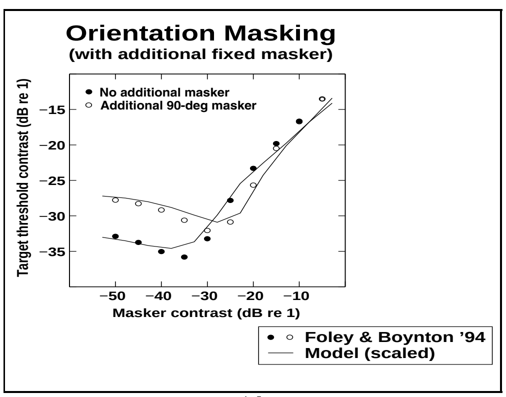

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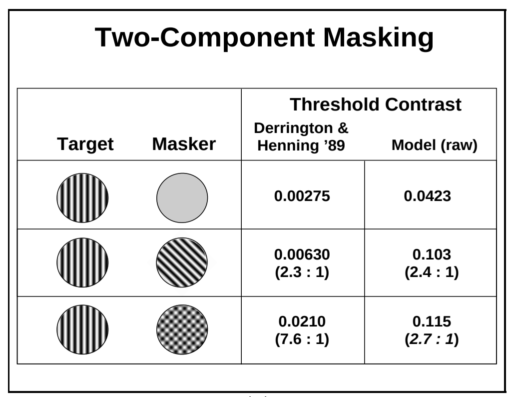

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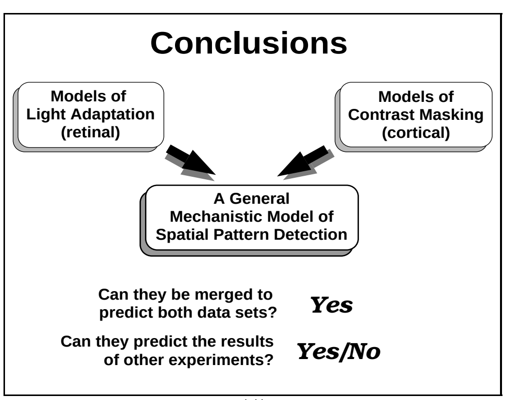

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