On the plausibility of the discriminant center-surround hypothesis for visual saliency

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It has been suggested that saliency mechanisms play a role in perceptual organization. This work evaluates the plausibility of a recently proposed generic principle for visual saliency: that all saliency decisions are optimal in a decision-theoretic sense. The discriminant saliency hypothesis is combined with the classical assumption that bottom-up saliency is a center-surround process, to derive a (decision-theoretic) optimal saliency architecture. Under this architecture, the saliency of each image location is equated to the discriminant power of a set of features with respect to the classification problem that opposes stimuli at center and surround.

In a previous work, we have shown that there is a one-to-one mapping between the discriminant saliency detector and a neural network that replicates the standard architecture of V1: a cascade of linear filtering, divisive normalization, quadratic non-linearity and spatial pooling [1].

In this work, we derive optimal saliency detectors for various stimulus modalities, including color, orientation, and motion, and show that these detectors make accurate quantitative predictions of several aspects of psychophysics of human saliency, for both static and motion stimuli. These include some classical non-linearities of orientation and motion saliency, and a Weber law that governs various types of saliency asymmetries, which are beyond the reach of previous saliency models. The discriminant saliency detectors are also applied to various saliency problems of interest in computer vision, including the prediction of human eye fixations on natural scenes, motion-based saliency in the presence of ego-motion, and background subtraction in highly dynamic scenes. In all cases, the discriminant saliency detectors outperform previously proposed methods, from both the saliency and the general computer vision literatures.

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References

[1] Decision-theoretic saliency: computational principle, biological plausibility, and implications for neurophysiology and psychophysics. D. Gao and N. Vasconcelos, submitted to *Neural Computation*, 2007.