COMBINING MULTIPLE CUES FOR CONTOUR INTEGRATION IN NATURAL SCENES

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Abstract Automatic extraction of shape-defining contours from natural images is an important practical problem which has proven to be extremely difficult in computer vision. One source of difficulty is that detection of a contour at any given location can depend on visual cues distributed over a large fraction of the image, and the rules for optimally combining evidence from many varied sources are complicated and poorly understood. We propose a neuromorphic approach that combines four sources of information to estimate the probability of a given contour hypothesis. Boosting sources arise from (1) long-range high-resolution contour structure in which learned prototypes are combined with a MAX-like operation, and (2) local coarse-scale input, which modulates the contour hypothesis through a multiplicative factor. Suppressive sources include (1) a measure of local edge density, which acts through divisive normalization, and (2) spatial mutual exclusion effects, including cross-phase inhibition, which act through subtractive normalization. We apply our network to complex real-world scenes, and find well-organized shape contours are selectively boosted while the much large number of disorganized local edge features are suppressed. The result is a crude line drawing. And we discuss several aspects of our approach that relate to organizational features of visual cortex, including the two very different forms of lateral inhibition, synaptic temporal dynamics, and nonlinear dendritic integration.