Neural Analog Diffusion-Enhancement Layer and Spatio-Temporal Grouping in Early Vis

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Abstract: A new class of neural network aimed at early visual processing is described; we call it a Neural Analog Diffusion-Enhancement Layer or "NADEL." The network consists of two levels which are coupled through feedfoward and shunted feedback connections. The lower level is a two-dimensional diffusion map which accepts visual features as input, and spreads activity over larger scales as a function of time. The upper layer is periodically fed the activity from the diffusion layer and locates local maxima in it (an extreme form of contrast enhancement) using a network of local comparators. These local maxima are fed back to the diffusion layer using an on-center/off-surround shunting anatomy. The maxima are also available as output of the network. The network dynamics serves to cluster features on multiple scales as a function of time, and can be used in a variety of early visual processing tasks such as: extraction of comers and high curvature points along edge contours, line end detection, gap filling in contours, generation of fixation points, perceptual grouping on multiple scales, correspondence and path impletion in long-range apparent motion, and building 2-D shape representations that are invariant to location, orientation, scale, and small deformation on the visual field.