Towards a simpler model of contour integration in early visual processing using a composite of methods.

T. Nathan Mundhenk, Laurent Itti
University of Southern California, iLab

iLab has been attempting to simulate contour integration in early visual preprocessing. Our model starts with a standard butterfly pattern of neural connections that excite or suppress neighboring neurons depending on their preferred visual orientation used for instance by Li (1998). This creates systems where neurons tend to excite other neurons with a collinear orientation, but tend to suppress neurons with a parallel orientation.

Our current model attempts to distance itself from many current models that use either neuro synchronization or cascade effect to obtain good contour detection. Instead, we have concentrated on a simpler composite model that uses group suppression gain control, multi scale image analysis and fast plasticity. In this, group suppression works by summing the excitation for small groups of neurons. If the group exceeds threshold, proportionately suppression among the group's neurons is increased. Fast plasticity works by increasing the excitatory ability of a neuron if it has been excited by neighboring neurons to a large enough extent. Finally, multi scale processing works by taking the result of processing the same image in multiple scales on the same neural kernel model at each scale.

Experiments on real world images shows that contours are most noticeably improved by the use of group suppression gain control, while tests on computer generated contours provided by Jachen Braun that are of varying size, phase and alignment shows improvement most from the use of fast plasticity and multi scale processing. Our results so far suggest that all three additions a both viable and helpful. Further, our model suggests that simpler mechanisms can be used by the brain in the act of early visual contour integration.

References:

Li, Z. (1998) A neural model contour integration in the primary visual cortex *Neural comput*. 10, 903-940

Author Information:

T. Nathan Mundhenk
University of Southern California
Computer Science Dept
Hedco Neuroscience Bldg, HNB 06, 3641 Watt Way,
Los Angeles, CA 90089-2520
mundhenk@usc.edu -
Tel / Fax: +1(213)740-6991 / 5687

Laurent Itti
University of Southern California
Computer Science Dept.
Hedco Neuroscience Bldg HNB30A, 3641 Watt Way,
Los Angeles, CA 90089-2520
itti@pollux.usc.edu
Tel/Fax: +1(213)740-3527/5687