

Boundary Detection Through Surround Modulation

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Edges are key components of any visual scene to the extent that we can recognise objects merely by their silhouettes. Human visual system captures edge information using neurons that are sensitive to both intensity discontinuities and particular orientations. The “classical approach” assumes that these cells are only responsive to the stimulus present within their receptive fields (RF), however, recent studies demonstrate that surrounding regions and inter-areal feedback connections influence their responses significantly. In this work we propose a biologically-inspired edge detection model based on these physiological findings.

surround [2], long range iso- and orthogonal-orientation surrounds along the primary and secondary axes of the RF [1], and we model far surround via feedback connections. These interactions are inversely dependant on the contrast of the RF [5]. V1 output signal is pooled at V2 by a contrast-variant centre-surround mechanism applied orthogonally to the preferred direction of the V1 RF [3]. To account for the impact of global shapes on local contours [2], we feed the output of V2 back into V1.

Our experiments suggest that V1 surround modulation strengthens edges while V2 suppresses undesired textural elements (Figure 2).

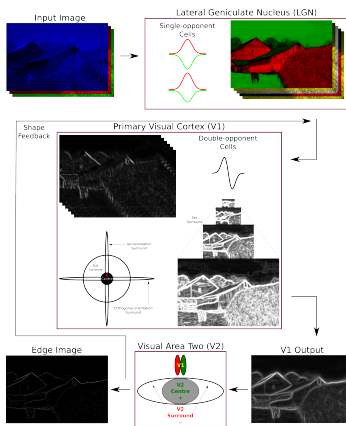


Figure 1: The flowchart of proposed model.

Figure 1 shows the schematics of our model. The original image is processed by balanced and imbalanced single opponent cells in the retina and sent through the lateral geniculate nucleus in the form of colour opponent channels [4]. Orientation is obtained in the primary visual cortex (V1) by convolving these channels with double-opponent cells (known to be responsive to colour edges [4]), whose RF we modelled through the first derivative of a Gaussian function. To consider the RF surround: we define a short range circular (isotropic) region corresponding to full

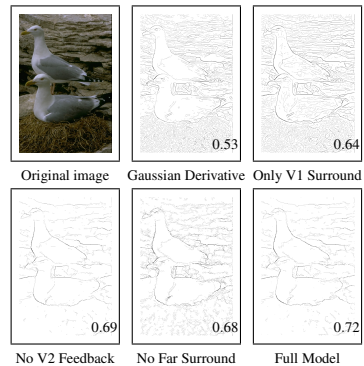


Figure 2: Components evaluation.

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