International Journal of Innovative
Computing, Information and Control
Volume **5**, Number **9**, September **2009**

 ISSN 1349-4198
pp. 2541–2549

A BIOLOGICALLY PLAUSIBLE MODEL OF CONTOUR DETECTION

Zhaoyu Pian, Liqun Gao and Li Guo

College of Information Science and Engineering
Northeastern University
No.11, Lane 3, WenHua Road, HePing District, Shenyang, Liaoning, P. R. China
bgfhdragon@126.com; gaoliqun@ise.neu.edu.cn; gl6290@126.com

Received March 2008; revised August 2008

Abstract. *In this paper, we present a new computational model for contour detection. The algorithm is inspired by the researches of neurophysiology, which have revealed that the response of a central stimulus in the receptive field is affected by its surrounding stimuli. The measure firstly simulates the response function of the visual cell by researching into the structure of the primary visual cortex. And then, a new neighboring effect term is proposed to characterize the interactions of surrounding cells. The term balances different effects of the surrounding stimuli based on considering the distance, position and orientation of the stimulus; moreover, normalized computational model reduces computational complexity effectively. Finally, two tests are implemented to verify the feasibility and the stability of the proposed detection model. The experimental results show that our measure is superior to other methods and effectively detects contours in a clutter background. Especially, the advantages are more prominent under the condition of complicated scene.*

Keywords: Edge, Contour detection, Receptive field, Gabor, Neighboring effect, Inhibition, Enhancement

1. **Introduction.** The researches of visual information show that the edge is a prominent feature of an image, and plays a key role in image processing, computer vision and pattern recognition. In the last decades, various algorithms for edge detection have been an explosive growth [1-3]. However, since these approaches can not distinguish the types of edges, such as ordinary edges, texture edges and contours edges, their results are usually sensitive to texture and contain lots of redundant information. Consequently, it is difficult to detect the object contour from complex texture background by these measures. Obviously, human visual perception makes such a difference in processing of visual information with them. No matter what kind of edge is: isolate edge or the edge in clutter background, it can be perceived correctly.

Neurophysiology has indicated that visual information is processed hierarchically in the primary visual cortex (V1) [4-6]. Firstly, the simple cell and the complex cell of V1 extract the primary features of visual information, such as edge, contour, texture and so on; then, the integrated features information are sent to other Hyper-complex cells for follow-up processing; finally, the clear, continuous contours are obtained by human perception. With the detailed studies, psychophysical researches have shown that a simple cell is not only activated by the stimulus in its receptive field (RF: a region in which an optimal stimulus elicits vigorous response from a neuron), but also affected by the presence of other stimuli in its neighbor [7-10]. For instance, in Figure 1, there are three colors: white, green and pink, but you may perceive the existence of the red color. That is because the simple cells which are response to pink are affected by the green stimuli in its neighbor, and the final responses turn red in your eyes; you were cheated by your eyes. This visual