

# Output Characteristics of Three-Layer Cellular Neural Networks Processing Color Images

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## SUMMARY

Cellular Neural Networks (CNN) [1] were introduced by Chua and Yang in 1988. The idea of the CNN was inspired from the architecture of the cellular automata and the neural networks. Unlike the conventional neural networks, the CNN has local connectivity property. Since the structure of the CNN resembles the structure of animals' retina, the CNN can be used for various image processing application [2]-[4] including character extractions [5][6]. Further, the CNN can be utilized to produce some kinds of pattern generation [7][8].

The humans retina have an ability distinguishing colors and consist of three types of cells called "cone" responding to the three primary colors and a cell called "rod" responding to the amount of light. The humans can recognize colors by the function of the cone cells. Roska et al. have proposed a concept using a three-layer CNN processing the three primary colors in [9]. They have confirmed that the three-layer CNN could produce half-toned images of color images. However, after their pioneering work, there have not been many researches on the CNN dealing with three primary colors of the image effectively.

In the previous study, we proposed the three-layer cellular neural network considering three primary colors (RGB-CNN) [10]. In our RGB-CNN, the connections between the three layers play an important role. Namely, the three layers do not operate independently but all the outputs influence to the other layers.

In this study, we investigate the output characteristics of the RGB-CNN in detail with various color images.

## REFERENCES

- [1] L.O. Chua and L. Yang, "Cellular Neural Networks:Theory," IEEE Trans. Circuits Syst., vol. 32, pp. 1257-1272, Oct. 1988.
- [2] F. Dirk and T. Ronald, "Coding of Binary Image Data using Cellular Neural Networks and Iterative Annealing," Proc. of ECCTD'03, vol. 1, pp. 229-232, Sep. 2003.
- [3] M. Namba and Z. Zhang, "Cellular Neural Network for Associative Memory and Its Application to Braille Image Recognition," Proc. of IJCNN'06, pp. 4716-4721, Jul. 2006.
- [4] H. Koeppl and L.O. Chua, "An Adaptive Cellular Nonlinear Network and its Application," Proc. of NOLTA'07, pp. 15-18, Sep. 2007.
- [5] T. Kozek, K.R. Crouse, T. Roska and L.O. Chua, "Smart Image Scanning Algorithms for the CNN Universal Machine," Proc. of NOLTA'95, vol. 2, pp. 707-712, 1995.
- [6] J. Kishida, C. Rekeczky, Y. Nishio and A. Ushida, "Feature Extraction of Postage Stamps Using an Iterative Approach of CNN," IEICE Trans. on Fundamentals, vol. E79-A, no. 10, pp. 1741-1746, Oct. 1996.
- [7] K.R. Crouse and L.O. Chua, "Methods for Image Processing and Pattern Formation in Cellular Neural Networks: A Tutorial," IEEE Trans. Circuits Syst., vol. 42, no. 10, pp. 583-601, Oct. 1995.
- [8] K.R. Crouse, L.O. Chua, P. Thiran and G. Setti, "Characterization and Dynamics of Pattern Formation in Cellular Neural Networks," International Journal of Bifurcation and Chaos, vol. 6, no. 9, pp. 1703-1724, 1996.
- [9] T. Roska, A. Zarandy and L.O. Chua, "Color Image Processing by CNN," Proc. of ECCTD'93, pp. 57-62, Aug. 1993.
- [10] T. Inoue and Y. Nishio, "Edge Enhancement of Color Image by Three-Layer Cellular Neural Network Considering Three Primary Colors," Proc. of NOLTA'08, Sep. 2008. (Accepted)