Abstract

Cellular Automata (CA) are common and most simple models of parallel computations. Edge detection is one of the crucial task in image processing, especially in processing biological and medical images. CA can be successfully applied in image processing. This paper presents a new method for edge detection of binary images based on two dimensional twenty five neighborhood cellular automata. The method considers only linear rules of CA for extraction of edges under null boundary condition. The performance of this approach is compared with some existing edge detection techniques. This comparison shows that the proposed method to be very promising for edge detection of binary images. All the algorithms and results used in this paper are prepared in MATLAB.

References

- Ulam, S. 1963. Some Ideas and Prospects in Biomathematics. Annual Review of Biophysics and Bioengineering. pp. 277-292.
- Neumann, J. V. 1966. Theory of Self-Reproducing Automata. University of Illinois Press.
- Wolfram, S. 1984. Computation Theory of Cellular Automata. Commun. Math. Phys. pp. 15-57.
- Canny, J. F. 1986. A Computational Approach to Edge Detection. IEEE Tran. On pattern Analysis and Machine Intelligence PAMI-8. 679-698.
- Khan, A. R., Choudhury, P. P., Dihidar, K., Mitra, S., Sarkar, P. 1997. VLSI architecture of cellular automata machine. Computers and Mathematics with Applications. 33(5). 79-94.
- Gonzalez, R. C. and Woods, R. E. 2002. Digital Image Processing. Second Edition. Prentice- Hall.
- Wongthanavasu, S. and Sadananda, R. 2003. A CA-based edge operator and its performance evaluation. Journal of Visual Communication and Image Representation. 14:83–96.
- Scarioni, A. and Moreno, J. A. 1998. Border detection in digital images with a simple cellular automata rule. In S. Bandini, R. Serra and F. S. Liverani (Eds.). Cellular Automata: Research towards Industry.
- Chang, C., Zhang, Y., Gdong, Y. 2004. Cellular Automata for Edge Detection of Images. IEEE proceedings on Machine Learning and Cybernetics. 26-29.
- Rosin, P. L. 2006. Training Cellular Automata for Image Processing. IEEE Trans. Image Processing. Vol. 15. No. 7 pp. 2076–2087.
- Rosin, P. L. 2010. Image Processing using 3-state Cellular Automata. Computer Vision and Image Understanding. Vol. 114. pp. 790–802.
- Chen, ang. and hao, e. G. Z. Wang. Cellular automata modeling in edge recognition.
- Lee, M. A. and Bruce, L. M. 2010. Applying Cellular Automata to Hyperspectral Edge Detection. IEEE (IGARSS). 2202-2205.
- Kazar, O. and Slatnia, S. 2011. Evolutionary Cellular Automata for Image Segmentation and Noise Filtering Using Genetic Algorithms. Journal of Applied Computer Science and Mathematics. 10 (5). 33-40.
- Djemame, S. and Batouche, M. 2012. Combining Cellular Automata and Particle Swarm Optimization for Edge Detection, International Journal of Computer Applications. vol. 57. No. 14. 16-22.
- Hong, W., Hong-jie, Z., Hua, W. 2004. Image Segmentation Arithmetic Based on Fuzzy Cellular Automata. Fuzzy Systems and Mathematics. No. 18. pp. 309-313.
- Zhang, K., Li, Z., Zhao, X. 2007. Edge Detection of Images based on Fuzzy Cellular Automata, Eighth ACIS International Conference on Software Engineering, Artificial Intelligence, Networking, and Parallel/Distributed Computing, IEEE.
- Patel, D. K. and More, S. A. 2013. Edge detection technique by fuzzy logic and Cellular Learning Automata using fuzzy image processing. IEEE conf. (ICCCI). pp. 1-6.
- Choudhury, P. P., Nayak, B. K., Sahoo, S., Rath, S. P. 2008. Theory and Applications of Two-dimensional, Null-boundary, Nine-Neighborhood, Cellular Automata Linear rules. arXiv: 0804. 2346. cs. DM;cs. CC; cs. CV.
- Mohammed, J., Mohanty, B., Sahoo, S. 2012. Two-Dimensional Cellular Automata and its Reduced Rule Matrix. OMS. 31. No. 1, 97-104.
- Pradipta, M. and Chaudhuri, P. P. 2005. Fuzzy cellular automata for modeling pattern classifier. IEICE Trans Inf Syst. 88:691.
- Ziou, D. and Tabbone, S. 1998. Edge detection technique an overview. Pattern Recognition and Image Analysis 8 (4). pp. 537-559.

Index Terms

Computer Science  
Image Processing

Keywords

CA  TFNCA  Edge Detection  Neighborhood  Linear Rule  Null- Boundary.