

## Chapter 7

# Processing and Recognition of Images Based on Asynchronous Cellular Automata

### ABSTRACT

*This chapter discusses the use of asynchronous cellular automata with controlled movement of active cells for image processing and recognition. A time-pulsed image description method is described. Various models and structures of cellular automata for transmitting active signals are presented. The image of the figure is binarized and an active signal moves along its edges. At every moment in time, the active cell of an asynchronous cellular automaton generates a pulse signal. The shape of the generated pulse sequence describes the geometric shape of a flat figure. Methods for describing images of individual plane figures, as well as a method for describing images consisting of many separate geometric objects, are proposed. Cellular automaton is considered as an analogue of the retina of the human visual canal. The circuitry structures of cells of such asynchronous cellular automata are presented, and the software implementation of the proposed methods is also performed. Methods allow one to classify individual geometric image objects.*

DOI: 10.4018/978-1-7998-2649-1.ch007

## INTRODUCTION

In previous chapters, ACA models were considered in which active signals were transmitted to neighboring cells that are in a given information state, and their neighborhood cells also have a given logical state. Such ACAs have been classified as ACAs with controlled transmission of active signal (Bilan, 2017). In them, the active signal can be transmitted only in the right direction. ACA with this structure can be effectively used in tracking systems. They are also effectively used for image processing and recognition. (Belan, 2011; Belan, & Belan, 2012; Belan, & Belan, 2013; Bilan, 2014).

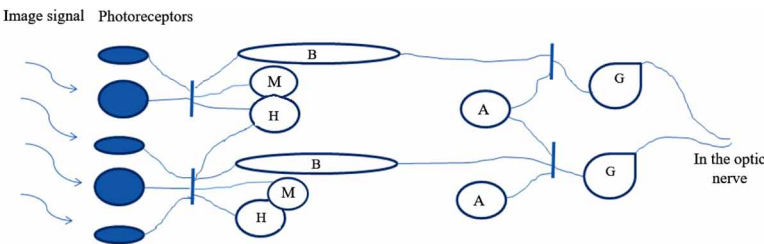
In addition, ACA with controlled transmission of active signals are effectively used to simulate various processes. Such ACAs are little studied today in terms of various evolutionary paradigms, as well as in terms of their application in scientific research and industry. This chapter discusses the use of ACA with controlled movement of active signals for processing and recognition of 2D images.

The purpose of this chapter is to build methods and means for describing and classifying images of flat geometric shapes based on an ACA with controlled movement of the active signal, which allowed us to create a system that simulates the functions of an analog of the human visual channel.

## RETINA ANALOG OF OPTIC CHANNEL BASED ON CELLULAR AUTOMATA

Modern studies of the physiological structure of the retina of the human visual canal have made it possible to determine the main structural elements and the relationships between them (Schachar, et al 2017; Fineman, 2018;

Figure 1. Simplified horizontal retinal cut model



47 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: [www.igi-global.com/chapter/processing-and-recognition-of-images-based-on-asynchronous-cellular-automata/263060](http://www.igi-global.com/chapter/processing-and-recognition-of-images-based-on-asynchronous-cellular-automata/263060)

## Related Content

---

### A Holistic Approach to Teaching the Process of Problem Solving: A Curriculum of Nonroutine Problems

Robert (Bob) H. London (2022). *Global Perspectives and Practices for Reform-Based Mathematics Teaching* (pp. 79-98).

[www.irma-international.org/chapter/a-holistic-approach-to-teaching-the-process-of-problem-solving/301351](http://www.irma-international.org/chapter/a-holistic-approach-to-teaching-the-process-of-problem-solving/301351)

### Polytopes of the Highest Dimension in the Theory of Heredity

(2022). *The Classes of Higher Dimensional Polytopes in Chemical, Physical, and Biological Systems* (pp. 335-362).

[www.irma-international.org/chapter/polytopes-of-the-highest-dimension-in-the-theory-of-heredity/304423](http://www.irma-international.org/chapter/polytopes-of-the-highest-dimension-in-the-theory-of-heredity/304423)

### An Introduction to NeutroHyperstructures on Some Chemical Reactions

Fakhry Asad Agusfianto, Madeleine Al Tahanand Yudi Mahatma (2023). *NeutroGeometry, NeutroAlgebra, and SuperHyperAlgebra in Today's World* (pp. 81-96).

[www.irma-international.org/chapter/an-introduction-to-neutrohyperstructures-on-some-chemical-reactions/323469](http://www.irma-international.org/chapter/an-introduction-to-neutrohyperstructures-on-some-chemical-reactions/323469)

### Algorithm

(2024). *Utilizing Visuals and Information Technology in Mathematics Classrooms* (pp. 201-217).

[www.irma-international.org/chapter/algorithm/346427](http://www.irma-international.org/chapter/algorithm/346427)

### Neutro Boolean Algebra: An Extension of Classical Boolean Algebra

Somen Debnath (2022). *Theory and Applications of NeutroAlgebras as Generalizations of Classical Algebras* (pp. 76-89).

[www.irma-international.org/chapter/neutro-boolean-algebra/302852](http://www.irma-international.org/chapter/neutro-boolean-algebra/302852)