Chapter 4
Models and Paradigms of Cellular Automata With Several Active Cells

ABSTRACT

The chapter describes the models and paradigms of asynchronous cellular automata with several active cells. Variants of active states are considered in which an asynchronous cellular automaton functions without loss of active cells. Structures that allow the coincidence of several active states in one cell of a cellular automaton are presented. The cell scheme is complicated by adding several active triggers and state control schemes for active triggers. The VHDL models of such cells were developed. Attention is paid to the choice of local state functions and local transition functions. The local transition functions are different for each active state. This allows you to transmit active signals in different directions. At each time step, two cells can change their information state according to the local state function. Asynchronous cellular automata have a long lifecycle.

INTRODUCTION

The chapter describes the models and paradigms of asynchronous cellular automata with several active cells. Variants of active states are considered in which an asynchronous cellular automaton functions without loss of active cells. Structures that allow the coincidence of several active states in one cell

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of a cellular automaton are presented. The cell scheme is complicated by adding several active triggers and state control schemes for active triggers. The VHDL - models of such cells was developed. Attention is paid to the choice of local state functions and local transition functions. The local transition functions are different for each active state. This allows you to transmit active signals in different directions. At each time step, two cells can change their information state according to the local state function. Asynchronous cellular automata have a long life cycle.

MODEL AND PRINCIPLES OF FUNCTIONING OF CELLULAR AUTOMATA WITH SEVERAL ACTIVE CELLS

Based on the ACA with one active cell, pseudorandom number generators (PRNGs) were constructed, which were investigated using statistical tests ENT, NIST (Bilan, 2017; Bilan, Bilan, & Bilan, 2015; Bilan, et al 2016), as well as using graphical tests (Bilan, 2017). Studies have allowed the analysis of ACA with one active cell. However, ACA studies with several active cells have not been conducted. Studies have been conducted for an ACA with one active cell and for various forms of organizing neighborhoods. In such ACAs, at each time step, only one cell changes its state.

Studies show that the small dimension of an ACA with one active cell does not give a long life cycle. The increase in the number of active cells allows you to extend the length of the ACA life period.

The structure of an ACA with several active cells has the same structure as an ACA with one active cell. Moreover, each ACA cell with several active cells has more advanced functional capabilities. A cell of such an ACA has a different structure since it can operate in four modes. It is taken into account that ACA contains two active cells.

- Standby mode;
- The mode of the first active cell;
- The mode of the second active cell;
- The mode of the first and second active cells.

The standby mode is characterized by the fact that the cell is not active and is in a logical state of “1” or “0”. In the active state, the cell performs LSF and can change its information state according to LSF. The result of