Chapter 6
Pseudorandom Number Generators Based on Asynchronous Cellular Automata and Cellular Automata With Inhomogeneous Cells

ABSTRACT
The sixth chapter deals with the construction of pseudo-random number generators based on a combination of two cellular automata, which were considered in the previous chapters. The generator is constructed based on two cellular automata. The first cellular automaton controls the location of the active cell on the second cellular automaton, which realizes the local state function for each cell. The active cell on the second cellular automaton is the main cell and from its output bits of the bit sequence are formed at the output of the generator. As the first cellular automaton, an asynchronous cellular automaton is used in this chapter, and a synchronous cellular automaton is used as the second cellular automaton. In this case, the active cell of the second cellular automaton realizes another local function at each time step and is inhomogeneous. The algorithm for the work of a cell of a combined cellular automaton for implementing a generator and its hardware implementation are presented.

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MODELS AND ALGORITHMS OF PSEUDORANDOM NUMBER GENERATOR OPERATION

We have considered the possibility of building a pseudorandom number generator based on a cellular automata. In fact, this cellular automata is a key element of the pseudorandom number generator and also determines its behavior. The changes its state is carried out by the internal organization of the cellular automata. However, the interaction of a several cellular automata is curious. Until now, are not shown and the various options to influence the behavior of one cellular automata by other CA are not considered.

How CAs can influence each other’s behavior?

1. The CA can change the state of all the cells.
2. CA may change the state of the selected cell at each time step.
3. CA can modify the structure of the neighborhood of one or all of the cells.
4. CA can modify the local transfer function of one of CA cells, or all of the CA cells.
5. CA can change the location of the main cells or of the inhomogeneous cells.

Thus, the above influence the cellular automata on cellular automata will be begin from dividing them onto controlled cellular automata (cellular automata, which receives control signals) and the control cellular automata (the cellular automata, which generates control signals).

Let us consider the influence of ACA on the HCA. Both of those cellular automata in the previous sections are considered. The first ACA operates as an asynchronous cellular automata. It has only one active cell changes its state at each time step of the ACA work. The second HCA function as a classic cellular automata with inhomogeneous cells.

The outputs of the each ACA cell to the control inputs of the respective HCA cells are connected. The ACA output signals change the behavior of the corresponding HCA cell. The simplest example of the PRNG controlling based on the HCA is a change in the location of the major HCA cell. The main HCA cell generates a sequence of bits at each time step. The first ACA influences on the coordinates of the main HCA cells by changing of the coordinates location of the active ACA cell. This allows to enter the additional uncertainty in the distribution of elements in the output sequence.
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