RARCHICAL MODEL OF THE INTERACTION OF MICROPROGRAMMED AUTOMATA

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A model of interaction of microprogrammed automata at the nodes of a hierarchical structure is suggested. The model allows minimizing in the constituent automata the number of inputs and outputs for communication signals; it is designed for decompositional synthesis of automata based on PLA with internal memory.

In the synthesis of control devices based on PLA with a memory (PLAM), methods for position of microprogrammed automata (MPA) are needed that are adjusted to the speci- of the system base, including the rigid constraints imposed by the external parameters (the number of inputs and outputs) on the parameters of the constituent automata. composition methods that minimize the number of communication signals sent between uent automata may be useful in this respect. One such method [1], introduces into circuit a communication automaton which controls the constituent automata. This method into account the specifics of PLAM as the core unit, but does not help accommodate specifics of the automata. Each of the onstituent automata in a network is much more than a communication automaton as measured by the number of input terminals, tran-, and states; using a single board PLA for each communication automaton is there- justified.

In this paper we propose a hierarchical model of interaction of constituent automata of these shortcomings.

The constituent automata in the model are the nodes of a hierarchical structure. A with communication automata [1] is a two-layer hierarchical structure. In addi- a greater number of control levels, it differs from the model of [1] in that it the possibility for each constituent automaton of the network to realize the ition and output functions of the initial automaton as well as the functions of the of the constituent automaton of the next hierarchical layer.

We will introduce definitions for the description of the hierarchical model of the tion of automata.

We will say that the root automaton is the "boss" of the roots of its subtrees; the are called "subordinates" of their "boss."

The relation of subordination on the set of constituent automata is a partial order . The fact that an automaton S^i is the "boss" of the automaton S^j - not necessar- the immediate boss - is written as $S_i > S^j$.

automaton S^m of the hierarchical circuit is called the "immediate boss" (IB) of automaton S^i, denoted $S^m = IB(S^i)$, if $S^m > S^i$, $S^n > S^i$ implies that either $S^n = S^m$ or . The automaton S^i in that case is called the "immediate subordinate" (IS) of S^m. of automata that are immediate subordinates of S^m will be denoted by $IS(S^m)$. $\in IS(S^m)$ if and only if $S^m = IB(S^i)$.

The least upper bound [2] S^k for the automata S^i and S^j will be called the "nearest boss" (NCB) of S^i and S^j: $S^k = NCB(S^i, S^j)$.

cording to this terminology, each automaton of the hierarchical network is a boss

Table 1

No.	a_i	a_j	$X(a_i, a_j)$	$Y(a_i, a_j)$
1	a_1	a_2	$\bar{x}_2\bar{x}_4$	y_1y_6
2		a_3	$x_1\bar{x}_2$	y_1y_5
3		a_3	$\bar{x}_1\bar{x}_2x_4$	y_6y_8
4		a_3	$x_2\bar{x}_3x_4$	y_5y_6
5		a_4	x_2x_3	y_1
6		a_5	$x_2\bar{x}_3\bar{x}_4$	y_1y_6
7	a_2	a_6	x_1x_3	y_1
8		a_7	$\bar{x}_3$	y_1y_6
9		a_7	$\bar{x}_1$	y_1y_6
10	a_3	a_4	1	y_6
11	a_4	a_5	$\bar{x}_5\bar{x}_6x_7$	y_6y_8
12		a_6	x_5x_6	y_1
13		a_7	$\bar{x}_5x_6$	y_1y_6
14		a_8	$x_5\bar{x}_6$	$y_1y_6y_8$
15		a_8	$\bar{x}_6\bar{x}_7\bar{x}_8$	$y_1y_6y_8$
16	a_5	a_6	$\bar{x}_7\bar{x}_2x_3$	$y_6y_7y_8$
17		a_7	x_7x_2	y_6
18		a_8	$\bar{x}_7x_2$	y_7y_8
19		a_9	$x_7\bar{x}_2$	—
20		a_{10}	$\bar{x}_2\bar{x}_3\bar{x}_7$	y_7
21	a_6	a_2	$x_3x_4\bar{x}_8$	y_3
22		a_3	$\bar{x}_3x_4$	y_1y_3
23		a_6	$x_3x_4x_5\bar{x}_6x_7x_8$	y_2y_4
24		a_7	$\bar{x}_4\bar{x}_5\bar{x}_7$	y_1
25		a_9	$\bar{x}_4x_5x_6$	y_1y_4
26		a_{10}	$\bar{x}_4x_5\bar{x}_6$	y_3y_4
27		a_{10}	$\bar{x}_4\bar{x}_6x_7$	y_3y_4
28		a_{11}	$\bar{x}_4\bar{x}_5x_6x_7$	$y_1y_2y_3$
29		a_{11}	$x_3x_4x_6x_8$	$y_1y_2y_3$
30		a_{11}	$x_3x_4\bar{x}_7x_8$	$y_1y_2y_3$
31		a_{11}	$x_3x_4x_5x_6$	$y_1y_2y_3$
32	a_7	a_8	1	y_1
33	a_8	a_6	$\bar{x}_1$	—
34		a_{11}	x_1	y_6
35	a_9	a_{13}	x_2	y_1
36		a_{14}	$\bar{x}_2$	y_5
37	a_{10}	a_{15}	x_1	y_6
38		a_{16}	$\bar{x}_1$	y_5y_6
39	a_{11}	a_1	$\bar{x}_2$	y_6
40		a_2	$x_2\bar{x}_8$	y_7y_8
41		a_{17}	x_2x_8	y_6y_7
42	a_{12}	a_3	$x_2x_3x_7$	y_7y_8
43		a_4	$x_2x_3\bar{x}_7$	y_8
44		a_5	$x_2\bar{x}_3$	y_7
45		a_6	$\bar{x}_2$	y_7y_8
46	a_{13}	a_7	$\bar{x}_3\bar{x}_5x_6$	y_9y_{10}
47		a_7	x_4x_6	y_9y_{10}
48		a_8	$\bar{x}_4x_5$	y_9y_{10}
49		a_9	$x_4\bar{x}_5$	$y_6y_9y_{10}$
50		a_9	$\bar{x}_4\bar{x}_5\bar{x}_6$	$y_6y_9y_{10}$
51	a_{14}	a_1	1	y_7
52	a_{15}	a_1	x_7x_8	y_6y_8
53		a_6	$x_7\bar{x}_8$	y_7y_8
54		a_7	$\bar{x}_7$	y_6
55	a_{16}	a_{11}	1	y_3
56	a_{17}	a_{12}	1	$y_6y_7y_8$

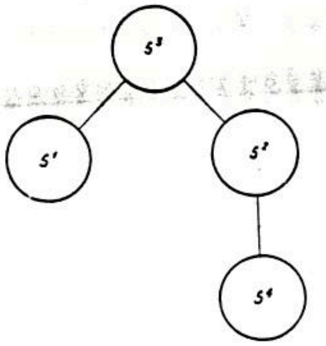

Fig. 1. Network structure in the decomposition of MPA S.

Table 2

Constituent Automaton S^1

a_i	a_j	$X(a_i, a_j)$	$\hat{Q}_j(S^1)$	$Y(a_i, a_j)$	$\hat{P}_j(S^1)$
a_6	b_1	$x_3x_4\bar{x}_8$	—	y_3	$P_2(S^1)=q_{31}q_{32}q_{33}$
	b_2	$\bar{x}_3x_4$	—	y_1y_3	$P_3(S^1)=q_{31}q_{32}\bar{q}_{33}$
	a_6	$x_3x_4x_5\bar{x}_6x_7x_8$	—	y_2y_4	$P_0(S^1)=\bar{q}_{31}\bar{q}_{32}\bar{q}_{33}$
	b_1	$\bar{x}_4\bar{x}_5x_7$	—	y_1	$P_7(S^1)=q_{31}\bar{q}_{32}q_{33}$
	b_1	$\bar{x}_4x_5x_6$	—	y_1y_4	$P_9(S^1)=q_{31}\bar{q}_{32}\bar{q}_{33}$
	b_1	$\bar{x}_4x_6\bar{x}_6$	—	y_3y_4	$P_{10}(S^1)=\bar{q}_{31}q_{32}q_{33}$
	b_1	$\bar{x}_4\bar{x}_6x_7$	—	y_3y_4	$P_{10}(S^1)=\bar{q}_{31}q_{32}q_{33}$
	b_1	$\bar{x}_4\bar{x}_6x_6x_7$	—	$y_1y_2y_3$	$P_{11}(S^1)=\bar{q}_{31}q_{32}\bar{q}_{33}$
	b_1	$x_3x_4x_6x_8$	—	$y_1y_2y_3$	$P_{11}(S^1)=\bar{q}_{31}q_{32}\bar{q}_{33}$
	b_1	$x_3x_4\bar{x}_7x_8$	—	$y_1y_2y_3$	$P_{11}(S^1)=\bar{q}_{31}q_{32}\bar{q}_{33}$
	b_1	$x_3x_4\bar{x}_5x_8$	—	$y_1y_2y_3$	$P_{11}(S^1)=\bar{q}_{31}q_{32}\bar{q}_{33}$
	b_1				
b_1	a_6	—	$Q_6(S^1)=q_{11}$	—	—
	b_1	—	$Q_0(S^1)=\bar{q}_{11}$	—	—

…bordinate at the same time. The exceptions are the automata of the last level, …are all subordinates, and the automaton of the first level, which is only a boss.

…e hierarchical network operates as follows.

…ring the operation of a particular constituent automaton, all the automata in the …a are in the special state of "waiting for a response" from particular subordinate …a. The other automata of the network are in the state of "waiting for a response" …e boss automaton.

…ch constituent automaton except for the root automaton and the leaf automata, is …ted with its boss and its subordinates. When transferring control to a subordinate, …tituent automaton goes into the state of waiting for its response. When transfer- …ntrol to a boss the automaton goes into the state of response waiting.

…e can define the constituent automata of a hierarchical network in formal terms. …scription will be illustrated by the decomposition of MPA $S(A, X, Y, \delta, \lambda, a_1)$ (A - is the …f states, X - are the sets of input and output signals, δ, λ - are the transition …tput function, respectively, and a_1 - is the initial state); it is defined by Table

…ppose that on the set A of the states of MPA S a partition $\pi=\{A^1, \ldots, A^U)$ is given …U is the number of partition blocks). In the example $\pi=(A^1, A^2, A^3, A^4\}=\overline{6}, \overline{1.2.3.7.8.9.10}, \overline{…4.15.16.17}, \overline{4.13}$. We will perform the decomposition of this MPA according to the structure …n Fig. 1.

… The set B^u of the states of a constituent MPA S^u consists of the set A^u of the …f the corresponding partition block, the state b_u of request waiting, and the set …he states of response waiting: $B^u=A^u \cup \{b_u\} \cup C^u$, where $C^u=\bigcup_{S^i \in IS(S^u)} c_u(S^i)$, $c_u(S^i)$ is the state …S^u during the operation of its subordinate MPA S^i. In this example: $B^1=\{a_6, b_1\}$; …$a_2, a_3, a_7, a_8, a_9, a_{10}, b_2, c_2(S^4)\}$; $B^3=\{a_5, a_{11}, a_{12}, a_{14}, a_{15}, a_{16}, a_{17}, c_3(S^1), c_3(S^2)\}$; $B^4=\{a_4, a_{13}, b_4\}$.

Table 3

Constituent MPA S^2

a_i	a_j	$X(a_i, a_j)$	$\hat{Q}_j(S^2)$	$Y(a_i, a_j)$	$\hat{P}_j(S^2)$
a_1	a_2	$\bar{x}_3\bar{x}_4$	—	y_1y_5	—
	a_2	$x_1\bar{x}_2$	—	y_1y_5	—
	a_3	$\bar{x}_1\bar{x}_2x_4$	—	y_5y_6	—
	a_3	$x_2\bar{x}_3x_4$	—	y_5y_6	—
	$c_2(S^4)$	x_2x_3	—	y_1	$P_4(S^2)=q_{41}q_{42}$
	b_2	$x_2\bar{x}_3\bar{x}_4$	—	y_1y_6	$P_5(S^2)=q_{31}q_{32}q_{33}$
a_2	b_2	x_1x_3	—	y_1	$P_6(S^2)=q_{31}q_{32}\bar{q}_{33}$
	a_7	$\bar{x}_3$	—	y_1y_6	—
	a_7	$\bar{x}_1$	—	y_1y_6	—
a_8	a_8	$\bar{x}_1$	—	—	—
	b_2	x_1	—	y_6	$P_{11}(S^2)=q_{31}\bar{q}_{32}q_{33}$
a_9	$c_2(S^4)$	x_2	—	y_1	$P_{13}(S^2)=q_{41}\bar{q}_{42}$
	b_2	$\bar{x}_2$	—	y_5	$P_{14}(S^2)=q_{31}\bar{q}_{32}\bar{q}_{33}$
a_{10}	b_2	x_1	—	y_6	$P_{15}(S^2)=\bar{q}_{31}q_{32}q_{33}$
	b_2	$\bar{x}_1$	—	y_5y_6	$P_{16}(S^2)=\bar{q}_{31}q_{32}\bar{q}_{33}$
a_7	a_8	1	—	y_1	—
a_3	$c_2(S^4)$	1	—	y_6	$P_4(S^2)=q_{41}q_{42}$
b_2	a_1	—	$Q_1(S^2)=q_{21}q_{22}q_{23}q_{24}$	—	—
	a_2	—	$Q_2(S^2)=q_{21}q_{22}q_{23}\bar{q}_{24}$	—	—
	a_8	—	$Q_8(S^2)=q_{21}q_{22}\bar{q}_{23}q_{24}$	—	—
	a_9	—	$Q_9(S^2)=q_{21}q_{22}\bar{q}_{23}\bar{q}_{24}$	—	—
	a_{10}	—	$Q_{10}(S^2)=q_{21}\bar{q}_{22}q_{23}q_{24}$	—	—
	a_7	—	$Q_7(S^2)=q_{21}\bar{q}_{22}q_{23}\bar{q}_{24}$	—	—
	a_3	—	$Q_3(S^2)=q_{21}\bar{q}_{22}\bar{q}_{23}q_{24}$	—	—
	$c_2(S^4)$	—	$Q_{13}(S^2)=q_{21}\bar{q}_{22}\bar{q}_{23}\bar{q}_{24}$	—	$P_{10}(S^2)=q_{41}\bar{q}_{42}$
	$c_2(S^4)$	—	$Q_4(S^2)=\bar{q}_{21}q_{22}q_{23}q_{24}$	—	$P_4(S^2)=q_{41}q_{42}$
	b_2	—	$Q_0(S^2)=\bar{q}_{21}\bar{q}_{22}\bar{q}_{23}\bar{q}_{24}$	—	—
$c_2(S^4)$	a_7	—	$q_{21}q_{22}q_{23}$	—	—
	a_8	—	$q_{21}q_{22}\bar{q}_{23}$	—	—
	a_9	—	$q_{21}\bar{q}_{22}q_{23}$	—	—
	b_2	—	$q_{21}\bar{q}_{22}\bar{q}_{23}$	—	$P_5(S^2)=q_{31}q_{32}q_{33}$
	b_2	—	$\bar{q}_{21}q_{22}q_{23}$	—	$P_6(S^2)=q_{31}q_{32}\bar{q}_{33}$
	$c_2(S^4)$	—	$\bar{q}_{21}\bar{q}_{22}\bar{q}_{23}$	—	—

2. Put into correspondence to each block A^u of the partition π a set of input variables $\tilde{X}^u$ interrogated at the transitions from the states of this block: $\tilde{X}^u = \bigcup_{a_i \in A^u} X(a_i)$.

The input variables of the constituent MPA S^u are the elements of the set X^u and the elements of the set $Q(S^u)=\{q_{u_1},\dots,q_{u_n}\}$ of the additional variables sent to the input S^u: $X^u=\tilde{X}^u \cup Q(S^u)$. In the example: $X^1=\tilde{X}^1 \cup Q(S^1)=\{x_3, x_4, x_5, x_6, x_7, x_8, q_{11}\}$, $X^2=\tilde{X}^2 \cup Q(S^2)=\{x_1, x_2, x_3, x_4, q_{21}, q_{22}, q_{23}, q_{24}\}$, $X^3=\{x_2, x_3, x_7, x_8, q_{31}, q_{32}, q_{33}\}$, $X^4=\{x_3, x_4, x_5, x_6, x_7, q_{41}, q_{42}\}$.

3. For each block A^u of the partition π, we form a set $\tilde{Y}^u$ of the output variables generated at the transitions from the states of this block: $\tilde{Y}^u = \bigcup_{a_i \in A^u} Y(a_i)$. The output variables of the constituent MPA S^u are the elements of the set $\tilde{Y}^u$ and the elements of the set $P(S^u)$ of the additional variables sent to the inputs of the automaton IB (S^u) and each of IS (S^u):

$$Y^u=\tilde{Y}^u \cup P(S^u);\ P(S^u)=\bigcup_{S^i \in \text{IS}(S^u)} Q(S^i) \cup Q(\text{IB}(S^u)).$$

In the example:

$$Y^1=\tilde{Y}^1 \cup Q(S^3);\quad Y^2=\tilde{Y}^2 \cup Q(S^3) \cup Q(S^4);$$

$$Y^3=\tilde{Y}^3 \cup Q(S^1) \cup Q(S^2);\quad Y^4=\tilde{Y}^4 \cup Q(S^2).$$

4. We define the functions of the transitions δ^u and the outputs λ^u of the constituent automaton S^u. Suppose that in the initial MPA S there is a transition from a_i to a_j

Table 4

Constituent MPA S^3

a_i	a_j	$X(a_i, a_j)$	$\hat{Q}_j(S^3)$	$Y(a_i, a_j)$	$\hat{P}_j(S^3)$
a_{15}	$c_3(S^2)$	x_7x_8	—	y_6y_8	$q_{21}q_{22}q_{23}q_{24}$
	$c_3(S^1)$	$x_7\bar{x}_8$	—	y_7y_8	q_{11}
	$c_3(S^2)$	$\bar{x}_7$	—	y_6	
a_5	$c_3(S^1)$	$\bar{x}_7\bar{x}_2x_3$	—	$y_6y_7y_8$	q_{11}
	$c_3(S^2)$	x_7x_2	—	y_6	$q_{21}q_{22}q_{23}\bar{q}_{24}$
	$c_3(S^2)$	$\bar{x}_7x_2$	—	y_7y_8	$q_{21}q_{22}\bar{q}_{23}q_{24}$
	$c_3(S^2)$	$x_7\bar{x}_2$	—	—	$q_{21}q_{22}q_{23}q_{24}$
	$c_3(S^2)$	$\bar{x}_7\bar{x}_2\bar{x}_3$	—	y_7	$q_{21}\bar{q}_{22}q_{23}q_{24}$
a_{12}	$c_3(S^2)$	$x_2x_3x_7$	—	y_7y_8	$q_{21}\bar{q}_{22}q_{23}\bar{q}_{24}$
	$c_3(S^2)$	$x_2x_3\bar{x}_7$	—	y_8	$q_{21}\bar{q}_{22}\bar{q}_{23}q_{24}$
	a_5	$x_2\bar{x}_3$	—	y_7	—
	$c_3(S^1)$	$\bar{x}_2$	—	y_7y_8	q_{11}
a_{11}	$c_3(S^2)$	$\bar{x}_2$	—	y_6	$q_{21}q_{22}q_{23}q_{24}$
	$c_3(S^2)$	$x_2\bar{x}_8$	—	y_7y_8	$q_{21}\bar{q}_{22}\bar{q}_{23}\bar{q}_{24}$
	a_{17}	x_2x_8	—	y_6y_7	—
a_{14}	$c_3(S^2)$	1	—	y_7	$q_{21}q_{22}q_{23}q_{24}$
a_{16}	a_{11}	1	—	y_8	—
a_{17}	a_{12}	1	—	$y_6y_7y_8$	—
$c_3(S^1)$	a_{11}	—	$q_{31}q_{32}q_{33}$	—	—
	$c_3(S^2)$	—	$q_{31}q_{32}\bar{q}_{33}$	—	$q_{21}\bar{q}_{22}\bar{q}_{23}\bar{q}_{24}$
	$c_3(S^2)$	—	$q_{31}\bar{q}_{32}q_{33}$	—	$\bar{q}_{21}q_{22}q_{23}q_{24}$
	$c_3(S^2)$	—	$q_{31}\bar{q}_{32}\bar{q}_{33}$	—	$q_{21}q_{22}q_{23}\bar{q}_{24}$
	$c_3(S^2)$	—	$\bar{q}_{31}q_{32}q_{33}$	—	$q_{12}q_{22}\bar{q}_{23}\bar{q}_{24}$
	$c_3(S^2)$	—	$\bar{q}_{31}q_{32}\bar{q}_{33}$	—	$q_{21}\bar{q}_{22}q_{23}q_{24}$
	$c_3(S^2)$	—	$\bar{q}_{31}\bar{q}_{32}\bar{q}_{33}$	—	—
$c_3(S^2)$	a_{15}	—	$q_{31}q_{32}q_{33}$	—	—
	a_5	—	$q_{31}q_{32}\bar{q}_{33}$	—	—
	a_{12}	—	$q_{31}\bar{q}_{32}q_{33}$	—	—
	a_{11}	—	$q_{31}\bar{q}_{32}\bar{q}_{33}$	—	—
	a_{14}	—	$\bar{q}_{31}q_{32}q_{33}$	—	—
	a_{16}	—	$\bar{q}_{31}\bar{q}_{32}q_{33}$	—	—
	c_1	—	$\bar{q}_{31}q_{32}\bar{q}_{33}$	—	q_{11}
	c_2	—	$\bar{q}_{31}\bar{q}_{32}\bar{q}_{33}$	—	—

by the input signal X_n that results in the output signal Y_t: $\delta(a_i, X_h) = a_j$; $\lambda(a_i, X_h) = Y_t$, ...ose that $a_i \in A^u$. Four alternatives are possible:

$a_j \in A^u$, then $\delta^u(a_i, X_h) = \delta(a_i, X_h) = a_j$; $\lambda^u(a_i, X_h) = \lambda(a_i, X_h) = Y_t$;

$a_j \in A^k$ $(k \neq u)$, $S^k > S^u$, then in the automaton S^u: $\delta^u(a_i, X_h) = b_u$; $\lambda^u(a_i, X_h) = Y_t \cup P_j(S^u)$, where ...$P(S^u)$; in the automaton S^k: $\delta^k(c_k(S^u), Q_j(S^k)) = \delta(a_i, X_h) = a_j$, $\lambda^k(c_k(S^u), Q_j(S^k)) = Y_0$, where $Q_j(S^k)$ is ...junction of additional input variables causing S^k to go to the state a_j. In all ...$> S^m > S^u$): $\delta^m(c_m(S^u), Q(S^m)) = b_m$, $\lambda^m(c_m(S^u), Q(S^m)) = P_j(S^m)$;

$a_j \in A^k$ $(k \neq u)$, $S^k < S^u$. Then in the automaton S^k: $\delta^u(a_i, X_h) = c_u(S^k)$, $\lambda^u(a_i, X_h) = Y_t \cup P_j(S^u)$. In the ...on S^k: $\delta^k(b_k, Q_j(S^k) = \delta(a_i, X_h)) = a_j, \lambda^k(b_u, Q_j(S^k)) = Y_0$. In all $S^m(S^k < S^m < S^u)$: $\delta^m(b_m, Q(S^m)) = c_m(S^k)$, ...$Q_j(S^m)) = P_j(S^m)$.

$a_j \in A^k$ $(k \neq u)$, S^k and S^u do not lie on a common path to the root of the hierarchical ... Let S^r = NIB(S^k,S^u). Then, in the automaton S^u: $\delta^u(a_i, X_h) = b_u$, $\lambda^u(a_i, X_h) = Y_t \cup P_j(S^u)$. In ...maton S^k: $\delta^k(b_k, Q_j(S^k)) = a_j, \lambda^k(b_k, Q_j(S^k)) = Y_0$. In the automaton S^r: $\delta^r(c_r(S^u), Q_j(S^r)) = c_r(S^k)$, ...$Q(S^r)) = P_j(S^u)$. In all $S^m(S^r > S^m > S^k)$: $\delta^m(b_m, Q_j(S^m)) = c_m(S^k)$, $\lambda^m(b_m, Q_j(S^m)) = P_j(S^m)$. In all ...$> S^u$): $\delta^q(c_q(S^u), Q_j(S^q)) = b_q$, $\lambda^q(c_q(S^u), Q_j(S^q)) = P_j(S^q)$.

...ides $\delta^u(b_u, Q_0{}^u) = b_u$, $\delta^u(c_u(S^k), Q_0{}^u) = c_u(S^k)$, $\lambda^u(b_u, Q_0{}^u) = \lambda^u(c_u(S^k), Q_0{}^u) = Y_0$, where Q_0^u is the con-...n of the variables of the set U^u, all of whose terms are inverted.

...e number of additional input variables of the MPA S^u is defined as follows:

...s to the number of outputs due to an increased number of communication signals.

The interaction model always produces implementations with the number of PLAM boards ...ast not greater than model of [1], which is a particular case of the model suggested ...this paper.

The use of a hierarchical interaction model in MPA decomposition made it possible to ...e following compared with model of [1]: 1) reduce the number of interacting automata ...e network; 2) take into account the specifics of the connections of the automata and ...e the number of communication variables by introducing a sequence in the connection ...twork automata; and 3) expand the class of circuits implementing control automata ...LAM basis.

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