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MECHANISM SEQUENTIAL ACCESS OF PARTS OF DECOMPOSITION ON THE BASIS OF THE TECHNIQUE OF OPTIMAL CIRCUIT REDUCTION

There were considered the peculiarities of programmatic realization of mechanism sequential access of parts of decomposition of complex circuit. There were revealed main approaches of carrying out of starting optimization of sequential parts of decomposition.

1. Introduction

Decomposition of circuit is decomposition of circuit into parts according to given criterions of optimum. There turned out that approaches on the basis of the technique of optimal circuit reduction were the most effective for this task.

The technique of optimal circuit reduction consists in parallel – sequential wiring of subcircuits, which have the same or similar according to mutual nets elements of characteristics and turn out hierarchical clusteral structure of circuit on the basis of the great process of identification and combining of clusters and on the basis of the developed clusters there forms optimal reduction circuit tree T^R according to top-up strategy [1]. Optimal reduction Circuit tree is regarded as hierarchical tree of clusters, intermediate tops of which correspond to clusters of circuit. On the Fig. 1 there shown optimal reduction circuit tree, on the basis of which according to top-dawn and combining strategies there carries out initial decomposition of circuit into parts and optimization of decomposition. Instead of analysis of circuit on the level of main cells there caries out combinatorial analysis of hierarchical put clusters. That essentially reducts calculating difficulty and makes the quality of solving better.

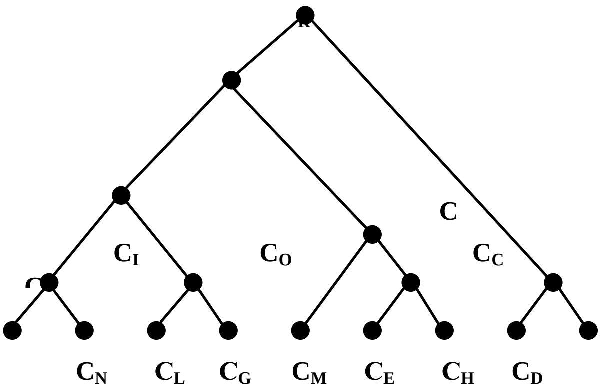

Fig. 1. Hierarchics of clusters in optimal reduction circuit tree.

2. Formulating of problem of decomposition of circuit into parts

Let $A = (P,E)$ is the given circuit;

where $P = \{p_1, \dots, p_n\}$ -set of cells of circuit A;

$E = \{e_1, \dots, e_m\}$ -set of nets of circuit A.

every net $e_i \in E$ connects some (two or move) cells of set P, which make subset $P(e_i) \subset P$. It is considered, that it is incidental to them. Input information according to projecting there comes out netlist of set E, which reflects the system of subsets for all these nets:

$P(E) = \{P(e_1), \dots, P(e_m)\}$;

$(\forall P(e_i) \in P(E),\ i = 1,\dots, m)[P(e_i) = \{p \in P \mid p \text{ is incidental to } e_i\}]$.

We consider the system $\tilde{P} = \{P_1, \dots, P_k\}$, to be decomposition $\tilde{P}$ of circuit A into parts, which satisfies conditions :

$$(\forall(P_i, P_j) \in \tilde{P})[P_i \cap P_j = \varnothing]; \ \bigcup_{i=1}^{k} \bigcup_{j=1}^{n_i} p_{ij} = P \ .$$

Where $P_i = \{p_{i1}, \ldots, p_{in_i}\}$ – set of all cells of part P_i;

$P_j = \{p_{j1}, \ldots, p_{jn_i}\}$ –set of all cells of part P_j .

It's necessary to find the best of possible decompositions, which satisfies the necessary limits. We can formulate the problem as finding such a decomposition $\tilde{P}$, when we reach extremum of meaning of criterion Q in admissible sphere D of possible solving.

3. Mechanism sequential access of parts of decomposition

The main idea of mechanism sequential access of parts of decomposition consists in the following, at first there builds optimal reduction tree T^R according to top-up strategy, which marks out sets of clusters C of circuit A, then according to top-down and combining strategies on the basis of primary got information they divide circuit A into parts $\tilde{P}$. According to the developed approach, they solve the problem in three steps: wiring of optimal reduction tree; initial decomposition; optimization of decomposition. So, in the process of building of optimal reduction tree, finally we get one or some clusters. If all the main cells have made one clusters. If all the main cells have made one cluster we get a tree, if some clusters we get a forest (some trees). In case of building of optimal reduction tree there formed a forest we get initial partition on n-parts in –quantity of formed trees). Lets consider the case in a proper way, when finally we get one tree.

On Fig. 2. there shown clusters of Optimal Reduction Tree, where T^R - vertex; C_A, C_B, C_C, C_I, C_R, C_O, C_P – clusters of optimal reduction tree; C_D, C_E, C_F, C_G, C_H, C_K, C_L, C_M, C_N – main cells, or clusters of optimal reduction tree.

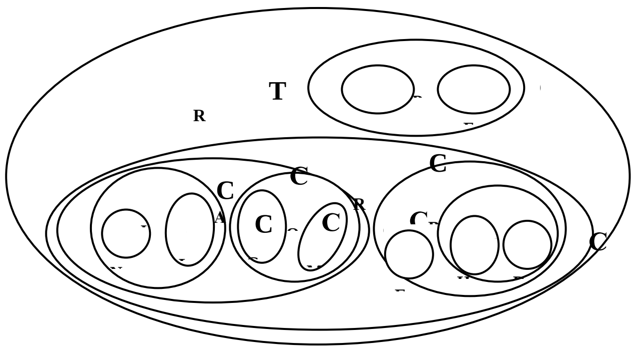

Fig. 2. Representation of clusters of reduction

Partitioning is made on the basis of the results of merging, which are kept in top–up reduction tree [5]. On the basis of this data there carried out analysis of the got clusters from set C (C_1, C_2, .. C_n) for partitioning tree into the necessary quantity of subcircuits P_1, P_2, …P_n which are equal. Mechanism of partitioning uses the same structures of data as mechanism of reduction (lists with the same direction and lists with ramification). In file there is kept information about every cluster (the name of cluster, cells which make it, information about nets, information about quantity of cells). On Fig. 3 there shown mechanism sequential access of parts of decomposition.

Process of finding the first subcircuit is carried out in such a way:

1. Setting the parts of decomposition and defining the quantity of cells, which one part (subcurcuit) has to maintain.
2. Reviewing reduction tree and finding cluster, which unites the necessary quantity of cells. If none of clusters is found, the quantity of cells, which make the necessary quantity, then we find cluster (subcircuit), the quantity of which is the closest to necessary meaning. We repeat the process in order to define necessary quantity of subcircuits.

So, we get the necessary quantity of parts, quantity of cells in which is the closest to quantity of cells, which one subcircuit should maintain and remainder (elements, which haven't entered into any of subcircuits). In order to arrange the remainder between the got subcircuits there carried out initial optimization with the following analysis.

For example, let's consider the case of bipartitioning. Initial optimization is carried out in such a way:

– Building of the table of connection for all cells and clusters, which haven't entered entered into any of subcircuits P_1, P_2, …P_n which is built for better imagining, working out and keeping in operative memory dependence with great quantity of main cells. The table of connection in operative memory is recorded as lists of data with the same direction, so it is better to work out the great data with spending less time;

- Defining effectiveness of replacement cells (clusters) from subcircuit P_1 into P_2 and vice versa;
- Arranging of clusters, which have better criterions of replacement of cluster into subcuircuit;
- Replacement of clusters, which have better criterions and quantity of main cells in which don't exaggerate the quantity of cells, which it-s necessary to replace into subcircuit. The process is carried out till one of subcircuits . The process is carried out till one of subcircuits is formed. All other elements (clusters) from remainder we replace into another part;
- Partitioning all clusters into main cells for every subcircuit;
- Building of Optimal Reduction Tree.

There can happen such a case, when in the first part all the main cells are reducted into one tree, but in the second part the forest is formed, it means that there are cells, which don't have the same connections with the cells, which are reducted into main tree. If all cells are reducted while reduction tree is built, then this problem according to partitioning of the tree we can remove in such a wag- we build a new table of connection and define effectiveness of replacement every cluster into another part. We replace cells, which have not reducted in the second part into the first part, while the same quantity of cells from the first part is replaud into the second part. Disadvantage of the following procedure is that the quantity of connections between parts of partitioning can be worse.

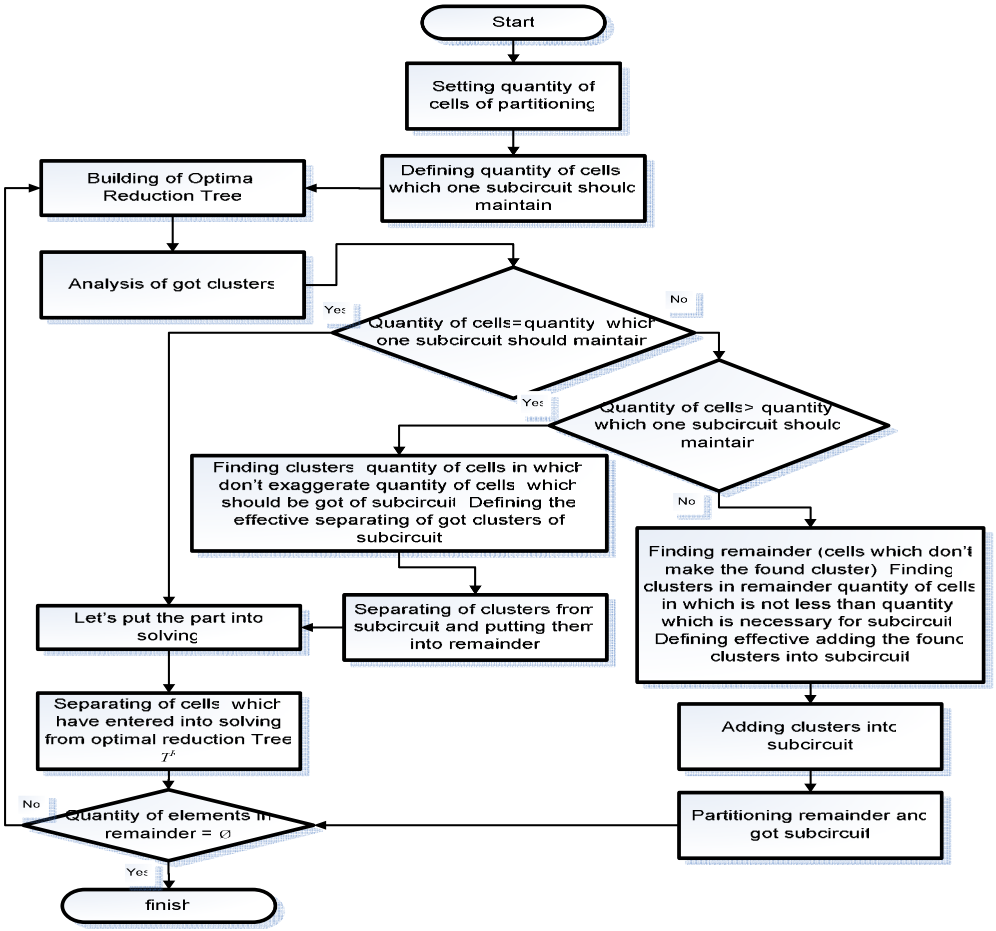

Fig. 3. Block-structure of mechanism sequential access of parts of decomposition.

Initial optimization is carried out with the usage of information about partitioning and its following analysis. Analysis of effectiveness of arranging remainder between parts is fulfilled by choosing of cluster (element) from the list with the given meaning of criterion. All the necessary information about realization of replacement of clusters is kept in output file of optimal reduction tree [5]. Minimum connections between parts of circuit is taken into consideration as criterion of replacement. It is formed by modification of list of indicator of effectiveness. The chosen cells are arranged between the parts of circuit, and process is carried out fill remainder is not arranged between the got subcircuits. In order to make, batter the characteristics of got subcircuits (quantity of connections between subcircuitts) there will be carried out partitioning optimization.

4. Experimental investigations

Investigations were carried out on the basis of real circuit of firm IBM [4]. This circuit maintains 12752 main cells and 14111 connections, which unite them [5] .

In the table there given some criterions of arranging main cells (remainder) between the parts of partitioning with usage of deflection %.

Quantity of cells	% deflection	Quantity of cells 1 part				Quantity of cells 2 part				Quantity of connections between parts			
		Kr_1	Kr_2	Kr_3	Kr_4	Kr_1	Kr_2	Kr_3	Kr_4	Kr_1	Kr_2	Kr_3	Kr_4
12752	0	6375	6376	6376	6376	6377	6376	6376	6376	484	502	616	460
12752	1	6313	6313	6312	6312	6439	6439	6440	6440	484	495	691	468
12752	2	6249	6249	6249	6249	6503	6503	6503	6503	503	579	607	469
12752	3	6185	6185	6185	6185	6567	6567	6567	6567	484	543	636	443
12752	4	6121	6121	6121	6121	6631	6631	6631	6631	481	525	594	446
12752	5	6058	6058	6058	6057	6694	6694	6694	6695	462	520	527	426
12752	6	5994	5994	5994	5994	6758	6758	6758	6756	450	461	567	448

In the table there introduced the following criterions of arranging remainder between subcircuits:

Kr_1-difference of quantity of external connections and effectiveness of replacement cluster portioned into quantity of cells, which make cluster; Kr_2- quantity of cells, which make cluster; Kr_3 – effectiveness of replacement cluster; Kr_4 – quantity of cells, which make cluster portioned into effectiveness of replacement cluster.

5. Conclusions

There were considered the peculiarities of programmatic realization of mechanism sequential access of parts of decomposition of complex circuits with usage initial optimization. There was used comparison of different criterions of arranging clusters between parts of decomposition on the pasis of experimental test ibm_01. The next investigations should be directed on the research of new mechanisms, which could provide better partition between parts of decomposition with less spent time.

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