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ANALYSIS OF INITIAL APPROXIMATION STRUCTURE AND TRAJECTORIES OF DESIGN OF ANALOG NETWORKS

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Various trajectories of design, arising from the new methodology of analog network design, are analyzed. Several major criteria suggested for optimal selection of initial approximation to the design process permit to minimize the machine time. The initial approximation point is selected with regard to the previously revealed effect of acceleration of design process. The concept of separatrix is defined making it possible to determine the optimal position of the initial approximation. The numerical results obtained for passive and active networks prove the possibility of optimal choice of the initial point in design process.

One of the important aspects of the improvement of large systems' design quality is how to diminish the time expended for the design. The known traditional methods of reduction of time required for electronic network analysis (based, for example, on the sparse matrix or decomposition techniques) have almost exhausted their potentialities. There arises the necessity for new approaches, able to cope with this problem under conditions which are more complicated — both from the viewpoint of structure and dimensions of the systems.

Based on the new formulation of the problem of electronic network design in terms of the optimal control theory [1–3], there opens a possibility to generalize the design process, and to control it to reduce the machine time. This approach helps, first of all, determine the design algorithm which is optimal in speed and, second, permits to compare the main characteristics of various strategies in the process of designing. The control of design process consists in redistribution of the machine time between the task of the network model analysis and the optimization itself — such redistribution can be performed at each step of the optimization. This opportunity appears due to a virtually unlimited number of different design strategies coming about from the suggested approach, and due to their different characteristics — first of all, the number of operations and processor time. Within the limits of this theory, the traditional strategy of design is only a representative among a large set of different design strategies.

As shown in the preceding works, the potential gain attainable by the optimal-in-time design strategy worked out based on this methodology, grows with dimensions and complexity of electronic networks. On the other hand, this potential gain (compared to traditional design) can be achieved only in the case of the truly optimal algorithm. One of the important issues in this context is the problem of investigation of major properties of the optimal algorithm, and of possible restrictions imposed on the optimal trajectory of design.

The process of design of an electronic circuit will be defined, in conformity with [1, 2], as the problem of minimization of a generalized objective function $F(X, U)$ expressed by the vector equation

$$X^{s+1} = X^s + t_s \cdot H^s \tag{1}$$

with constraints

$$(1 - u_j) g_j(X) = 0, \; j = 1, 2, \ldots, M, \tag{2}$$

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