OPTIMIZATION PROBABILITY OF THE UNFAILING WORK OF A NETWORK WITH USE OF STATISTICAL TESTS ON A MONTE-CARLO METHOD

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A reliability of systems with a network structure, for example, as telecommunication networks, is determined by a reliability of elements, making it, which can essentially differ on the reliability. At the analysis of a reliability the telecommunication networks usually is described graph, where the edges of the are reflected map the network channels, and as units act the workstations, servers, followers, switches, router or other devices. The parameters of a reliability frequently depend on a loading of a network (values of loadings of channels determining access of the users, and quality of their service). For this reason, formulating a problem of optimization of a reliability, it is necessary to determine, which of parameters are important: coherence, channel capacity, mean time to repair, time of recovery coherence or minimization of delay. Thanks to the structural redundancy of telecommunication networks, the refusal of the separate elements usually don’t result in full of the refusal of the network, and only to partial deterioration of quality of its functioning. The full of the refusal of a network (for example, in any separately of taken territory) can happen in the result of some large-scale acts of nature - floods, hurricanes, earthquakes, which can result in destruction of communication lines or to global switching-off of the power supply.

The quality of functioning of networks with switching of packages are usually evaluated by the loss of packages. These losses depend on the current condition of the elements of the network, etc. are described by random process, which we shall designate as e(t). Allowed value of mean losses of packages we shall designate as e^0. As refusal of the network in this case we shall name an occurrence of an event e (t)<e^0. Despite of the structural redundancy of the network, the problem of reliability of its elements remains rather actual. In this connection it is possible to formulate the following statement optimization of the problem: a maximization probability of the unfailing of a network with allowance for of specific criterion of the refusal e^0 at cost limitation on reserve of elements.

The problem of optimization of probability of the unfailing work of a network can be decided by the method of optimization on statistical realizations offered in [3,4]. The solution relating on modification of this method is resulted below [5]. This method was circumscribed also in [6] for the optimization of number of the channels in a communication network . The idea of a procedure of optimization with reference to probability of the refusal of a network with switching of packages can be formulated as follows.

Similarly to procedure in [4] the statistical experiment on a Monte-Carlo method [1] is carried out as independent for each separate element of a network. The distribution of time to repair of elements is considered uniform. In some moment the refusal of separate elements of a network can appear unnoticed, if these the refusals have not braked the condition of the functional of quality. At the failing the first element, which upsets the specific condition e^0 on the functional of quality - mean

losses of packages, the reserve for this element is introduced which in default of basic element here rises on its place.

During statistical simulation each time at the failing of the next element is introduced the appropriate reserve of element. Such procedure proceeds before full exhaustion of resources:

$$C(X) > C^0$$

where C^0 - limitation on the total cost of elements.

In the result of the first realization the first " vector of a reserve " of elements of a network is received.

$$X = (x_1, ..., x_n);\ x_i \text{ - number of reserve of elements of a } i\text{- type}, \quad i = 1, ..., n$$

During simulation for each realization the moment of the consumption of elements each of a *i*-type in each realization are stored independently. Having such construction thus trajectory of the consumption of reserve elements it is possible to decide a problem of selection of an optimum structure of the reserve elements [4]. In the case of optimization of probability of the unfailing work of a network it looks as follows: the possible structures of the reserve elements appropriate to the limiting condition are fixed. For network with the “*n*” elements such is located *n*-dimensional a cube satisfying to the condition $C(X)<C^0$, inside which the least number of trajectory is finished, i.e. where the least number of cases of the failing and accordingly probability of the unfailing work happens above. At the chosen structure of the reserve the probability of the unfailing work will be optimum.

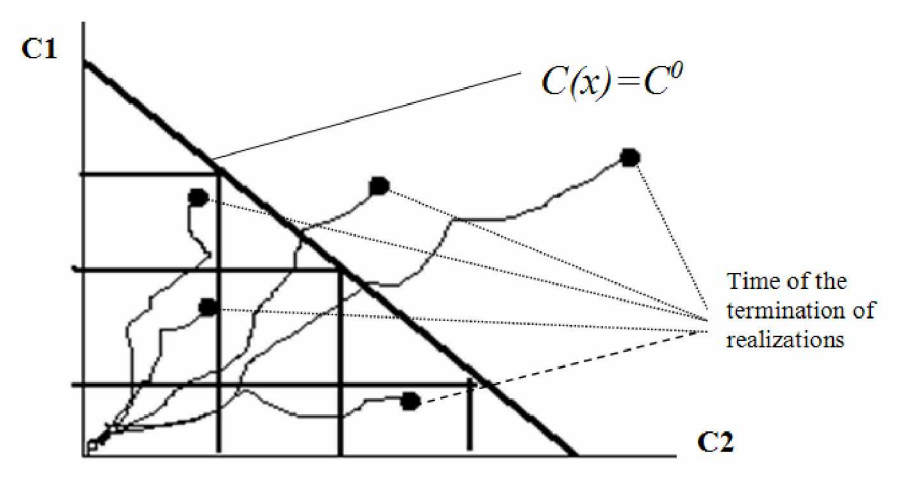

Fig 1. Selection of an optimum structure of the reserve for 2-dimensional case

On the figure 1 for convenience the example of selection of a "optimum" rectangle for two-dimensional case is shown. From all rectangles, inside which only one realization is finished , the mean and lower rectangle are optimal .

THE LITERATURE

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