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Collection of Information from Low Level Computers by a Central Computer in the Controlling Computer Complex

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This paper discusses a methodology of defining a frequency of data collection by a Central computer in the Controlling Computer Complex. An equation allowing defining a size of a Central computer memory that is needed to save collected information is also proposed.

One, even very power, computer is incapable to control a complex multistage technological process. This is why to control such processes computer complexes, consisting of a powerful Central computers and connected to them computers with limited productivity, are used [1]. This approach allows consider a control complex as a two level system. A Central computer is located on the upper level and controlling computers are located on the low level.

Central computer manage a whole technological process, while low level computers have limited tasks of controlling different technological stages. To be able function efficiently a Central computer periodically collects information from low level computers, develops controlling commands with consideration of a global technological task and downloads them into low level computers for the execution.

Usually Central computer collects only information that either is needed for the global technological control or is needed for the readjustment parameters controlled by low level computers. This collection is organized in such a way, that frequency of a collection is defined depending on frequency of intersection by controlled parameters some predefined thresholds.

This approach allows limiting a volume of information transmitted from low level computers to a Central computer. As a result, reaction of a Central computer to deviation of a technological process from preplanned execution can be shortened.

This vision of functioning of the Controlling Computer Complex allows us to formalize three problems related to the collection of information. Namely, 1) which technological parameters must be controlled; 2) how often low level computers have to be interrogated; 3) what size of memory has to be dedicated to each low level computer to store collected information.

In this paper we will try to find solutions for the two last problems.

Let’s start with the second problem. Each low level computer controls some specific and predefined technological parameters. We will consider that a value of a controlled parameter changes if deviation of it from previously measured value exceeds a predefined threshold. These deviations occur at random moments of time. Fluctuations of technological parameters are caused by multiple very often independent factors. Considering Palm’s theorem and additions made by Khinchin, deviations of *j*-th (j=1,2,..) controlled parameter represent a simple process [2] with intensity λ_j.

If information collected from *k*-th (*k*=1,2,…) computer consists of results of deviations of *m* (*m*=1,2,…) parameters, then combined flow of data from this computer will be represented also as a simple process with total intensity

$$\Lambda_k = \sum_{j=1}^{m} \lambda_{kj} \qquad (1)$$

(Since in our analysis we consider data flow from a general computer, we will omit index *k*).

Frequency *f=1/t* of data collection should be defined upon condition that during time *t* between two sequential collections, not more then *n (n < m)* parameters will deviate with probability $P_n(t)$ beyond predefined thresholds.

We can also define probability $P'_n(t)$ that during time *t* will deviate beyond predefined thresholds more then *n* parameters

$$P'_n(t) = 1 - \sum_{i=0}^{n} P_i(t) = 1 - e^{-\Lambda t} \sum_{i=0}^{n} \frac{(\Lambda t)^i}{i!} \qquad (2)$$

This equation allows us define a minimal frequency of data collection $f_{\min} = \frac{1}{t_{\max}}$ upon condition: $P_n^{'}(t_{\max}) \le P_{\max_n}^{'}(t)$; where $P_{\max_n}^{'}(t)$ is a maximal acceptable probability that more then *n* parameters will deviate beyond predefined thresholds.

Now let's consider a third problem. Information collected from low level computers is stored in the corresponding files of a Central computer. The number of memory cells *z* dedicated to each file has to be sufficient to store a file of a maximal expected length; however, to save memory space this number should be as small, as possible. The length of a file depends on how many parameters deviate during a collection cycle *t*. Considering stochastic nature of controlled parameters behavior, number of deviated parameters is random. We can define a number of memory cells *z* by considering the following condition: the probability $P_t(z)$ that number of dedicated to some file cells z will be insufficient should not exceed the maximal excepted probability $P_{\max_t}(z)$,

where $$P_t(z) = 1 - e^{-\Lambda t} \sum_{i=0}^{z} \frac{(\Lambda t)^i}{i!} \quad (3)$$

In this case, if we can accept some $P_{\max_t}(z)$, then we can find $z_{\min}$ that satisfies $P_t(z_{\min}) \le P_{\max_t}(z)$.

References

1. Golubev-Novozilov Yu.S. *Multicomputer Complexes*. Moscow, "Soviet Radio", 1967.
2. Khinchin A. Ya. *Queuing Theory*. Moscow, Fizmatgis, 1963.
3. Gnedenko B.V. Probability Theory. Moscow, Fizmatgis, 1961.