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TRANSPORTATION AS A DISCREET SYSTEM

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Abstract

Numerous procedures concerning the transport develop as accidental events the result and course of which depend on many occasional reasons.

Transport procedures are considered to be a cyclic random processes in discreet condition, that is why we suggest to use the Markov chain characteristics during the research as the transition from any S_i situation to S_{i+1} situation does not depend on how and when the system has passed to S_i situation.

Key words: transport, process, event, occasional, character, chain, characteristics.

Introduction

Transportation carries raw materials, fuel, materials, semi-finished products, consumer goods and other goods ensuring the production activities of all enterprises and organizations and the delivery of their products to consumers, while the products of one can be raw materials for another. In this way, transport facilitates the establishment of economic-production ties between the separate branches of enterprises [1,2].

Conflict setting

The task of improving the management of transport processes as a whole is very difficult, but objective conditions are offered for its solution at present. In practice, economic-mathematical methods are widely used for the planning of trucking, which allows you to select the best options for the organization of work and to identify available resources. Automated control systems are being successfully introduced in the field of transport.

The analysis of transport processes shows that there are a number of shortcomings in the system of organization of mass cargo transportation, which lead to unreasonable planning of the transport process and inefficient organization of rolling stock work.

Research results

In practice, the task for each car indicates the object of work, that is, the route and the number of passes during the shift.

The calculation of the shift work is made in the following expressions:

$$Q = \frac{T_r q \gamma \beta V_t}{l_c + \beta V_t t_{lu}}, \quad (1)$$

$$P = \frac{T_r q \gamma \beta V_t l_c}{l_c + \beta V_t t_{lu}}; \quad (2)$$

The analysis of these formulas shows that as the time in the schedule increases, the number of products increases linearly.

Considering the full-empty reciprocating swing route and the vehicle operating in it as a system (micro-system), it can be noted that such a system under the influence of the work done by the car successively switches from state S_0 (if no march) to state S_z (when performed n marches).

It should be noted that in the process of transportation, a transport product is created simultaneously which is measured as the amount of transported cargo or tons of work done.

The creation of a transport product takes place during the time when the loaded vehicle is moving from the loading point to the destination. However, as soon as the car stops for unloading, the production stops and resumes at the next exit of the car from the loading point.

The change in product quantity over time is shown in Fig. 1.

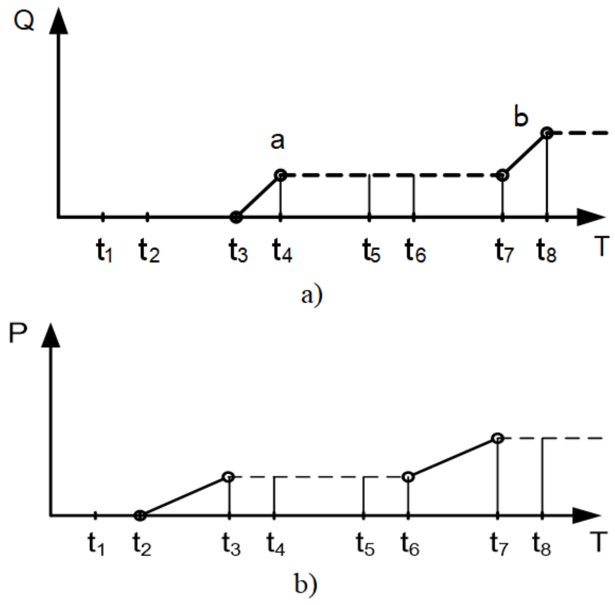

Fig. 1 Actual change over time
a - amount of transported cargo,
b - transport work performed

At that moment of t_1, the car stops for the first load, which ends at the moment of t_2. Arrival at the destination is determined by the moment at which unloading begins. The load is considered to have been delivered when the unloading is completed (at the moment of t_4) and the quantity of the load is shown in point a (Fig. 1 a).

Then the car leaves for the next loading and reaches the loading point at the moment of t_5. From here the actions of the transport process are repeated, and the moment t_8 corresponds to the performance of the next march. At the point of destination there will now be a load equal to the sum of the quantities of cargo transported during the two marches, which is determined by the ordinance of point b.

When observing the process of preparation (creation) of a transport product (t/km), we will notice that from time t_1 to time t_2 that product is not created (Fig. 1 b). It is produced from time t_1 to time t_2, as long as the car is in motion with the load, after which the production of the product stops. The preparation of the transport product is resumed at the moment of leaving the cargo point during the movement of the car. Output increases as load increases.

According to the presented schedules, the stages of receiving this or that transport product do not coincide, they are not continuous. The product manufacturing process corresponds to an intermittent linear dependence.

Many actions in this process develop as random events the outcome and course of which depend on many random causes. The transition from one situation of the system to another is by "flight" and, since each process can be counted (numbered), then the transport process is considered an intermittent process.

If we look at the system as an example of an FIT, it can go to a new situation at any unknown accident. In this regard, it should be noted that the transport process is a random discrete process at a constant time; and at the same time, the features of the Markov chain are unique to it because the transition from S_i situation to any S_{i+1} situation does not depend on when and how the system passed to the situation S_i [3, 4].

The graph of the state of the transport process as the system used for each vehicle is shown in Fig. 2.

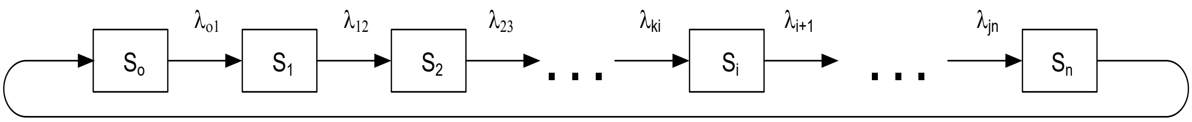

Fig. 2 Graph of transport process condition

S_1- one march is done, S_i- i march is done, S_n- n march is done

According to the constructed graph, the system switches from situation S_0 unilaterally to the following situations.

S_1 - 1 march was made,

S_i - i march was performed,

S_n - n march performed.

However, with each shift or every day, such a system goes back to normal S_0 condition. This transition can be made from any S_i state. Moreover, if the number of trips i is equal to the planned number, then the shift (day) plan is fulfilled, otherwise it is not fulfilled or is overfulfilled. Therefore, the transport process is considered to be a cyclically random process with a discrete state which is characterized by the number of complete marches in any period [1, 2, 4].

If we denote the probability P_{ij} of passing from situation S_i to situation S_j in one step, and the probability P_{ii} of delay in state S_i. Moreover, in this case the step is considered to be the completed walk, and P_{ii} - is a function of the length of the load, the speed of transport work and the loading-unloading line.

Knowing the probabilities of these quantities, one can calculate the probability of switching from system situation S_i to situation S_j at time t_k. In other words, the magnitudes of the probabilities of passing all pairs λ_{ij} of situation can be found S_i S_j by these quantities.

Knowing the quantities λ_{ij}, we can make a graph describing the situation of the system, which, in turn, will allow to determine the probabilities of these situations as functions from t [2, 3].

$$P_1(t), P_2(t), \dots, P_n(t):$$

We show the system of equations for the graph under discussion (Fig. 2).

$$\left.\begin{aligned} P_0 &= \frac{1}{1+\lambda_{01}\left(\frac{1}{\lambda_{12}}+\frac{1}{\lambda_{23}}+\dots+\frac{1}{\lambda_{0n}}\right)}, \\ P_1 &= P_0\frac{\lambda_{01}}{\lambda_{12}}, \\ P_1 &= P_0\frac{\lambda_{01}}{\lambda_{23}}, \\ &\dots\dots\dots, \\ P_i &= P_0\frac{\lambda_{01}}{\lambda_{ii+1}}, \\ P_n &= P_0\frac{\lambda_{01}}{\lambda_{n0}}: \end{aligned}\right\} \quad (3)$$

The formulas express the marginal probabilities of this cyclical process. The description can be presented in a more convenient way if we use the average time $\bar{t}_i$ of the system S_i to be in place instead of λ_{ij}.

If the process is Markovian, then the law of time distribution does not depend on how long the system has been in a particular S_i situation. This means that the system is as it would be if the system were in a state of flux and that is nothing but a demonstrative law of the T - time distribution between adjacent events.

The parameter of that law is $\lambda_{i,i+1}$, and the average time of system is in S_i state.

$$t_i = \frac{1}{\lambda_{ii+1}} \quad (4)$$

From here

$$\lambda_{ii+1} = \frac{1}{t_i} \quad (5)$$

when, $i = n$ then by cycling

$$\lambda_{n0} = \frac{1}{t_n} \quad (6)$$

Putting these expressions in $P = \frac{T_r q \gamma \beta V_t l_c}{l_c + \beta V_t t_{lu}}$ and making changes, we get

$$P_0 = \frac{\bar{t}_0}{\bar{t}_0+\bar{t}_1+\cdots+\bar{t}_n}, \tag{7}$$

$$P_1 = \frac{\bar{t}_1}{\bar{t}_0+\bar{t}_1+\cdots+\bar{t}_n}, \tag{8}$$

or in general

$$P_k = \frac{\bar{t}_k}{\sum_0^n \bar{t}_i}. \tag{9}$$

Thus, the marginal probabilities of states in a cyclic system are considered as the mean of the system times in each situation. The marginal probability of the system is the totality of the plan and forecast. In this case, the forecast is a tool (or a set of different ways) by which the system reaches this or that situation, and the plan is one of the most chosen (directive) directions to reach the probable state of the system.

Conclusion

1. Transport procedures are considered to be a cyclic random processes in discreet condition, that is why we suggest to use the Markov chain characteristics during the research as the transition from any S_i situation to S_{i+1} situation does not depend on how and when the system has passed to S_i situation.
2. An AMC can be presented as a system combining multiple routes on any business day each of which corresponds to a certain graph of condition. It is proposed to construct a similar graph for the AMC, that is the AMC system can also be in the S_0 state and subsequently switch to the S_i situation, returning to the S_0 situation by cyclic equation.

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ՏՐԱՆՍՊՈՐՏԱՅԻՆ ԳՈՐԾԸՆԹԱՑԸ ՈՐՊԵՍ ԴԻՍԿՐԵՏ ՎԻՃԱԿՈՎ ՀԱՄԱԿԱՐԳ

Հակոբյան Բ.Դ., Գասպարյան Ա.Պ.
Շուշիի տեխնոլոգիական համալսարան

Տրանսպորտային գործընթացի բազմաթիվ գործողություններ զարգանում են որպես պատահական իրադարձություններ, որոնց ելքը և ընթացքը կախված են պատահական բնույթի շատ պատճառներից:

Տրանսպորտային գործընթացը համարվելով ցիկլիկ պատահական գործընթաց՝ դիսկրետ վիճակով, առաջարկվում է ուսումնասիրության ժամանակ կիրառել Մարկովի շղթայի հատկանիշները, քանի որ ցանկացած S_i վիճակից S_{i+1} վիճակին անցումը կախված չէ, թե երբ և ինչպես է համակարգն անցել S_i վիճակին:

Բանալի բառեր. տրանսպորտ, գործընթաց, իրադարձություն, պատահական, բնույթ, շղթա, հատկանիշ:

ТРАНСПОРТНЫЙ ПРОЦЕСС КАК СИСТЕМА С ДИСКРЕТНЫМ СОСТОЯНИЕМ

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Многие операции транспортного процесса развиваются как случайные события, ход и исход которых зависит от многих причин случайного характера.

Рассматривая транспортный процесс как циклический случайный процесс с дискретным состоянием, предлагается в ходе исследования применить свойства Марковской цепи, так как переход из любого состояния S_i в состояние S_{i+1}не зависит от того, когда и как система пришла в состояние S_i.

Ключевые слова: транспорт, процесс, событие, случайный, характер, цепь, свойство.

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