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THE CONSTRUCTION OF EFFECTIVE ALGORITHMS FOR NUMERICAL ANALYSIS OF MULTILINEAR SYSTEMS WITH REPEATED CALLS

Sergey N. STEPANOV

Institute for Problems of Information Transmission
USSR Academy of Sciences Moscow, USSR

ABSTRACT

Our aim is to describe the general approach to constructing the numerical methods of probabilistic characteristics estimate of system with repeated calls. The approach being applied an upper bound of estimate error is calculated together with probabilistic characteristics estimate.

1. INTRODUCTION

As a rule,authors construct models with repeated calls according to the following traditional scheme.A servicing system with one or some incoming Poisson flows of primary calls is considered. Being refused servicing a subscriber repeats the call with a probability in exponentially distributed time.Service time of primary or repeated calls is exponentially distributed.These assumptions being fulfiled the model functioning is described by Markovian process with infinite number of states,which in most simple cases has a form (j,i),where j is the number of repeated subscribers and i is the number of busy lines.

2. METHOD DESCRIPTION

Estimate construction method is based on the property of strong decreasing of P(j,i)(probability of state (j,i)) with moving off j from its mean value or decreasing of i.Thus,it is possible to choose an area of states out of which the existence of process that describes the model functioning is almost equal to 0. The borders of the area (which we call further "reduced") may be found simply enough if a concrete model with repeated calls is considered proceeding from physical principles of system operating or after using some approximate technique. It is clear that if we take characteristics of Markovian process defined only on "reduced" state space as estimate of corresponding characteristics of initial model we should obtain a good approximation. The main part of the problem is to find the error of estimation.It can be solved if the Markovian process,defined on the "reduced" space of states,will majorize the Markovian process (or some of its components),described the initial model. It will be achieved by adding auxiliary fictitious calls into the "reduced" model.

Two types of estimates are to be considered.

2.1 Upper bounds

Let us substitute the initial space of states S (see Fig.1) by the space of states A that is given by m cutting levels on number of busy lines i and m cutting levels on number of repeating subscribers j.Let us denote by G a border of A. In G we include the states from which the initial process can move out of A after one step (on Fig.2,which shows "reduced" space of states A, we mark these states by *).Majorizing process in states $(j,i)\in A\setminus G$ is fuctioning by the usual way. If $(j,i)\in G$ then transition of the process into state with less number of busy lines due to ending of service time for one of busy line is impossible. It can be achieved by instantaneous addition to the system on service of the fictitious call.It will be shown that as a result of such substitution we obtain upper bounds for probabilistic characteristics of the initial model and find the calculating error in terms of probabilistic characteristics of process defined on "reduced" space of states.This method,compared with traditional one,when we take as "reduced" a space of states of rectangular type (see Fig.3) several times improves the accuracy of probabilistic characteristics calculation.

2.2 Effective estimates

Here majorizing process is also functioning as initial process in states $(j,i)\in A\setminus G$ but if $(j,i)\in G$ then as result of ending of service time for one of busy lines we immediately get into state (j-1, i). Such behaviour close to the natural behaviour of the initial process on the border. This allows to improve accuracy of estimates, introduced in 2.1 approximately in 10 times.However,the estimates obtained here can be either upper,or lower (it depends on situation) that impedes their error study.

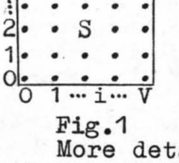

Fig.1

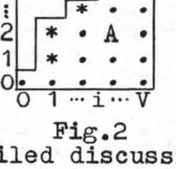

Fig.2

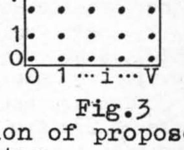

Fig.3

More detailed discussion of proposed method will be published later.