6th International IFS and Contemporary Mathematics Conference

June, 07-10, 2019 Mersin Turkey

CONFERENCE PROCEEDING BOOK

EDITOR

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PREFACE

We are very pleased to introduce the abstracts of the 6th International IFS and Contemporary Mathematics Conference (IFSCOM2019).
As previous conferences, the theme was the link between the Mathematics by many valued logics and its applications.

In this context, there is a need to discuss the relationships and interactions between many valued logics and contemporary mathematics.

Finally,in the previous conference, it made suceessful activities to communicate with scientists working in similar fields and relations between the different disciplines.

This conference has papers in different areas; multi-valued logic, geometry, algebra, applied mathematics, theory of fuzzy sets, intuitionistic fuzzy set theory, mathematical physics, mathematics applications, etc.

Thank you to all paticipants scientists offering the most significant contribution to this conference.

Thank you to Scientific Committee Members, Referee Committee Members, Local Committee Members, University Administrators, Mersin University Mathematic Department.

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MATHEMATICAL MODEL OF THE EFFECTIVENESS OF ADAPTIVE AUTOMATED CONTROL SYSTEMS IN EDUCATIONAL ORGANIZATIONS

ZH.KH. ZHUNUSSOVA, S.SH. IXANOV, AND K.A. DOSMAGULOVA

ABSTRACT. Creation of adaptive automated control systems in educational organizations is an actual problem. In the process of training students and students, the need for remote control devices increases in accordance with the objectives of training and evaluation criteria. In connection with this, automated control systems are introduced, and this research provides a mathematical model of the adaptive device and meets the requirements for use in production. As for institutions of higher education, in many buildings, turnstiles, light sensors, movements, local automation systems are installed at all access and exit facilities, allowing for the inclusion and switching-off of external and stand-by lighting, taking into account the time of the year. These data in educational buildings create information flows that need to be matched with a mathematical model of material and energy balance using an adaptive control system. The final result of the calculations is the minimization of the objective function of the cost of maintaining the educational building in a robust state, taking into account external evaluations on the quality of training (the results of examinations). It's about fixing students and teachers who enter the class in accordance with the schedule. Its effectiveness also reduces the filling of attendance documents. We conduct calculations for the study and implementation of an automated control system and describe it in mathematical formulas. The coefficients of consumption and efficiency of the system are graphically presented.

1. INTRODUCTION

The creation of adaptive automated control systems in educational organizations is a topical problem. In the process of training pupils and students, the need for remote control devices increases in accordance with the objectives of the training and evaluation criteria [1]. In this regard, automated control systems are being introduced, and this study provides a mathematical model of an adaptive device and meets the requirements for use in production. As for higher educational institutions, in many buildings, turnstiles, light sensors, movements, and local automation systems are installed at all access and exit objects, allowing for switching on and

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off external and emergency lighting, taking into account the season. These data in educational buildings create the flow of information that must be matched with a mathematical model of material and energy balance using an adaptive control system [2]. The final result of the calculations is the minimization of the objective function of the cost of maintaining the educational building in a workable state, taking into account external assessments of the quality of education (exam results). It is about fixing students and teachers who enter the class in accordance with the schedule. Its effectiveness also reduces the completion of attendance documents [3-5].

2. Preliminaries

This mathematical model in the representation of a queuing system has three states: I - both turnstiles are operational; II - one of the turnstiles is not working; III - both turnstiles are faulty.

The average operating time of the turnstile is $t = 30$ days, and the average recovery time is $t_B = 0.1$ days.

Then the failure rate of one turnstile will be equal to:

$$\lambda = \frac{1}{t} = \frac{1}{30} = 0.03$$

We also find the recovery rate of a single turnstile:

$$\mu = \frac{1}{t_B} = \frac{1}{0,1} = 10$$

In state I, both turnstiles are operational, therefore:

$$\lambda_{1,2} = 2 * \lambda = 2 * 0.03 = 0.06$$

In state II, one turnstile is working, therefore: $\lambda_{2,3} = \lambda 0.03$ In state II, one turnstile is restored: $\mu_{2,1} = \mu = 10$.

In state III all two turnstiles are restored: $\mu_{3,2} = 2 * \mu = 10 * 2 = 20$.

Probability of maintaining the state of the turnstile when both turnstiles are operational: $p_1 = \frac{1}{1+\frac{\lambda_{1,2}}{\mu_{2,1}}+\frac{\lambda_{1,2}\lambda_{2,3}}{\mu_{2,1}\mu_{3,2}}} = 0,994$. Probability of state II, when only one turnstile is working:

$$p_2 = \frac{\lambda_{1,2}}{\mu_{2,1}} * p_1 = 0.006.$$

Similar method: $p_3 = \frac{\lambda_{1,2}}{\mu_{2,1}} * p_2 = 0.00004$. For each turnstile we calculate the through put - the probability of serving the application:

$$Q = 1 - p_c = 1 - \frac{\rho_n}{n!} \quad \rho_1 = 1 - \frac{0.00004}{3!} = 0.9999.$$

3. The automated control system for access control

Consider this automated access control system as a task with a limited queue length.

Consider the following task:

It is necessary to find the optimal number of turnstiles if people pass through the turnstile with an intensity of 5 people per minute, and the average duration of one pass is 3 seconds.

To solve there

$$\lambda = 5min^{-1}, \bar{t} = 0.05, \mu = \frac{1}{\bar{t}} = 20min^{-1} p = \frac{\lambda}{\mu} = 0.25.$$

The number of turnstiles will be considered for any n. The following formulas for finding probabilities will help in calculating the maintenance of channels: $p_0 = (1 + \frac{p}{1!} + \frac{p^2}{1!}) + \cdots + \frac{p^n}{n!})^{-1}$. Probability of the turnstile failure (when the turnstile is broken or busy):

$$p_c = \frac{p^n}{n!} * p_0 = \frac{p^n}{n!} * (1 + \frac{p}{1!} + \frac{p^2}{1!}) + \cdots + \frac{p^n}{n!})^{-1}.$$

The probability that the application will be processed (a person will pass through the turnstile): $p_i = 1 - p_c = 1 - \frac{p^n}{n!} * (1 + \frac{p}{1!} + \frac{p^2}{1!}) + \cdots + \frac{p^n}{n!})^{-1}$. Average number of channels occupied by the service:

$$A = \lambda * Q\lambda * (1 - \frac{p^n}{n!} * p_0)$$

$$\overline{n} = \frac{A}{\mu} = p * *(1 - \frac{p^n}{n!} * p_0).$$

According to the calculations we make the following table:

n=	1	2	3
p_0	0,8	0,78	0,7789
p_c	0,2	0,024	0,002
p_i	0,8	0,976	0,998
$\overline{n}$	0,2	4,88	4,99
A	4	0,244	0,2495

According to the table, conclusions can be drawn from the following expressions: in educational organizations, as adaptive automated control systems, the optimal number of turnstiles can be considered as n equal to 1, when according to the data 0.8 applications are being processed in 5 minutes. At the same time, on average, 4 applications are serviced per minute. The calculations performed lead to the fact that for an educational building with a small number of turns from the turnstile in the usual time with a constant intensity of students it is enough to use one turnstile.

As a result, we present the exact calculation formula necessary for further calculation:

$$A = \lambda * (1 - \frac{p^n}{n!} * (1 + \frac{p}{1!} + \frac{p^2}{1!} + \cdots + \frac{p^n}{n!})^{-1}).$$

It should also be borne in mind that in the case of an increase in the number of passes and the application, it is necessary to carry out calculations using the above formulas in order to find the exact number of turnstiles in need of use.

For example, a calculation with small digital parameters was shown.

We carry out calculations for the study and implementation of an automated control system and describe it in mathematical formulas. The consumption and efficiency factors of the system are graphically represented, and a practical task is also presented and solved using the Markov process of death and reproduction.

Markov processes and probability theory can be used on the basis of the theory of automated control system.

The automated control system for access control, as a task with a limited queue length are described in the paper. To solve the problem of a queuing system with several turnstiles or with an unlimited queue length when calculating the turnstile failure time, it is necessary to carry out many numerical calculations. Also in this article, under finding the optimal number of turnstiles n, only up to three turnstiles are calculated. Accordingly, increasing the number of turnstiles, the probability approaches to zero. For reliable and accurate calculations, it is not enough to calculate analytically. Therefore, we use the C++ program and check the operation of the program comparing the results obtained with the table above.

The program is written for integer n and real $l, m, p, a, b, c, A, i, sum$. For convenient calculation, the following substitutions have been used:

$a = p_0, b = p_c, c = p_i, i = \overline{n}$, A calculated without changes. The sum as $1 + \frac{p}{1!} + \frac{p^2}{1!} + \cdots + \frac{p^n}{n!}$ denote sum.

Then step by step using the formulas we get the result that displays on the console window.

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