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Modeling of the Process of Medical Service in Medical and Preventive Institutions

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Abstract: The issues of modeling and machine implementation of the medical care process in medical institutions using the methods of the theory of queuing systems are discussed in this article. Particular attention is paid to calculating and evaluating the average number of requests in the buffer and serving devices, the average time spent by requests in the system; average waiting time for requests in the queue; number of free and busy service channels. A generalized algorithm for calculating of these indicators is proposed.

Key words: medical care, queuing system, number of patients treat, average interval of visits, average service time, service rules, random number generation

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3d Modeling for Predicting the Environmental Impact of The Aydar-Arnasay Lake System Under Different Scenarios, Changes in the Water Management Situation

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Abstrsact. The research is studied spatial distribution of the filtration characteristics of the territories of the Aidar-Arnasay Lake System (AALS) within the Republic of Uzbekistan. The data of natural-technogenic objects obtained as a result of analysis and schematization of hydrogeological conditions are generalized, and the hydrogeological parameters of the aquifer are calculated. The principles of constructing a geo-information system based on modern GIS technologies are developed, the boundary and initial conditions are justified, a regional mathematical model of the AALS territory is developed based on modern modeling programs Vizual Modflow for analyzing and assessing the dynamics of the development of AALS and its relationship with the components of the geological environment. The factors of groundwater formation are given and evaluated taking into account changes in water management conditions, their current state is highlighted, and recommendations are given for substantiating the tasks of groundwater monitoring in these territories.

Key words: Underground water, GIS, mathematical modeling, boundary conditions, the influence of the lake system, geofiltration process, data base, groundwater abatement, groundwater monitoring, water resource management.

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An Electronic Digital Signature Algorithm Based on a Composition of Computational Difficulties: Discrete Logarithm, Factorization, and Addition of Points of an Elliptic Curve

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Abstract: The article developed a new algorithm for electronic digital signature in the composition of existing difficulties: discrete logarithm in a finite field, decomposition of a sufficiently large natural number into prime factors, addition of points with rational coordinates of the elliptic curve. Based on a combination of the complexities of a discrete logarithm on a finite field with a large number characteristic, decomposition of a sufficiently large odd number into prime factors, and addition of points of an elliptic curve, an electronic digital signature algorithm is developed for generating. The generally recognized scheme (model) of electronic digital signature covers three processes: generation of digital signature keys; EDS formation; verification (confirmation of authenticity) of electronic digital signature. The design idea of the proposed algorithm allows you to modify and increase cryptographic strength with the addition of other computational difficulties. It is intended for use in information processing systems for various purposes in the formation and authentication of electronic digital signatures.

Key words: algorithm, electronic digital signature, prime factors, elliptic curve, hash value, Euler function, generation, correctness, cryptographic strength

INTRODUCTION

The electronic digital subscript in the electronic document, received because of special transformations of the information of the given electronic document with usage. Of the closed key of an electronic digital subscript and allowing by means of an open key of an electronic digital subscript establishes the lack of distortion of the information in the electronic document and identifies the owner of the closed key of an electronic digital subscript.

Existing algorithms of an electronic digital subscript is developed based on one of computing complexity: expansions on prime factors, a discrete taking the logarithm, and addition of points of an elliptic curve and [1-5].

1. PROBLEM STATEMENT

In this article on the basis of a combination of complexities of the discrete logarithm on the final field with the great number, expansions of enough big odd number on prime factors and additions of points of an elliptic curve develops Algorithm of the Electronic Digital Subscript (AEDS) for shaping and acknowledgement of authenticity of an electronic digital subscript (EDS) under the set message (the electronic document), transmitted on not protected telecommunication channels of the general use [7-9].

2. SOLUTION OF STATEMENT OF A PROBLEM

Following labels are used:
   M - the message;

$H(M)$ - hash-value of message M;

p_1, q_1 - big enough prime numbers, i.e. $p_1 > 2512$ and $q_1 > 2512$;

$n = p_1 q_1$ - the great number suffices;

$\varphi(n)$ - Euler's function;

a - an integral number defined from equality $ed - a\varphi(n)=1$;

d, x - integral numbers - closed keys of EDS;

k - signed a chosen random number from an interval $1 < k < q$;

e, y - integral numbers and Q- a point on an elliptic curve - open keys of EDS;

G- a base point on the chosen elliptic curve;

q - a prime number defining an order of a base point G;

(r, s, γ) - triple of integral numbers, an electronic digital subscript under *the M* message;

The conventional scheme (model) of an electronic digital subscript envelops three processes [6-7]:

- Generation of keys of EDS;
- Shaping EDS;
- Check (authenticity acknowledgement) EDS.

The basic mathematical definitions and the requirements superimposed on plants of algorithm of a digital subscript are given below.

For a subscript of message M, the signing by generating keys: e- opened and d- confidential of comparison $de1 \equiv \bmod \varphi(n)$ where the great number suffices $n=p_1q_1$, p_1q_1 – unknown prime numbers (satisfying to conditions $p_1>2512$, $q_1>2512$), $\varphi(n)$ - Euler's function, for accuracy $p_1>q_1$, let gets out a random number k and x, and $1<k<q$, q - a prime

number and $q<q_1$, $1<x<q$ and
NOD $(x, n)=1$, the parameter $g<n$ gets out on condition NOD$(q, n)=1$ and $g^q \mod n \neq 1$, and also q is not a divider $\varphi(n)$.

Open keys are: $y=g^{axd} \mod n$ the number an is defined from equality $ed - a\varphi(n)=1$ and $Q=[x]G$, where G- the base point having an order q (where q - a prime number), on the chosen elliptic curve.

In algorithm of EDS it is used following parameters [10-12]:

1) Open keys: y - generated by a rule $y=g^{axd} \mod n$, and $1<x<q$ where confidential keys x and d, are known only to the signed person; e – generated from comparison $de1 \equiv \mod \varphi(n)$; Q - an elliptic curve point generated by a rule $Q=[x]G$, where G- the base point having an order q, on the chosen elliptic curve;

2) Hashing function $H(M)$ which under the initial message (text) M forms an integral number in a range from 1 to q, i.e. $1<H(M)<q$.

3) Each user of AEDS should possess personal keys:

a) d, x - integral numbers - closed keys of EDS and signed a chosen random number k from an interval $1<k<q$;

b) y - an integer and Q - a point on an elliptic curve - open keys of EDS.

The prime number q is opened and can be the general for group of users.

Processes of shaping of an electronic digital subscript under the message of the user and authenticity acknowledgement.

For realization of the given processes, it is necessary, that to all users parameters of algorithm of an electronic digital subscript were known. Besides, each user to have closed key of EDS (d, x) and open key of EDS (e, y, Q).

For creation of an electronic digital subscript under *the M* message, it is necessary to fulfil following operations (pitches).

3. ALGORITHM SUBSCRIPT GENERATION

Input data: message M, initial parameters, confidential and discovery keys.

Output data: a subscript (r, s, γ).

Pitches of algorithm of generation of a subscript:
1. To calculate value $H(M)$ according to M, i.e. $h=H(M)$.

2. On the chosen random number k (to keep it a secret and to destroy at once after deriving subscripts) it is calculated: $[k]G=(x_1, y_1)$.

3. It is calculated: $r = g^{x_1 d} \mod n \mod q$.

4. It is calculated: $\rho = g^d \mod n$.

5. It is calculated: $s = [k^{-1}(H(M)\rho + r\rho x)] \mod q$.

6. It is calculated: $\gamma = (g^{-ax}\rho) \mod n$.

7. A subscript is triple: (r, s, γ).

Further the signed message is transmitted a receiving leg.

For acknowledgement of authenticity of EDS under received message M it is necessary to fulfil following operations (pitches).

4. ALGORITHM SUBSCRIPT CHECK

Input data: message M, initial parameters, an open key of check of a subscript and a subscript to M - triple (r, s, γ).

Output data: the statement that a subscript valid or not the valid.

1. If conditions $1 \leq r$, $s < q$ also $1 \leq \gamma < n$ are broken, «a subscript not valid» and to finish algorithm work.

2. To calculate value $H(M)$ according to M, i.e. $h=H(M)$.

3. To calculate: $w = y^e \mod n$.

4. To calculate: $\beta = w\gamma \mod n = \rho \mod n = \rho$ as $\rho < n$.

5. To calculate: $u_1 = [s^{-1}H(M)\beta] \mod q = s^{-1}H(M)\rho - a_1 q$.

6. To calculate: $u_2 = (s^{-1}r\beta) \mod q = s^{-1}r\rho - a_2 q$.

7. To calculate: $[u_1]G + [u_2]Q = (x_2, y_2)$.

8. If $u = \beta^{x_2} \mod n \mod q = r$, a subscript valid, differently the void.

5. CORRECTNESS OF AEDS

For the correctness proof it is necessary to show to justice equality: $[u_1]G + [u_2]Q = (x_2, y_2) = (x_1, y_1) = [k]G$. Really, from expression

$$s = (H(M)\rho + r\rho x) \; k^{-1} \mod q$$

We discover:

$k = [s^{-1}(H(M)\rho + r\rho x)] \mod q =$

$[s^{-1}H(M)\rho + s^{-1}r\rho x] \mod q =$

$s^{-1}H(M)\rho + s^{-1}r\rho x - a_3 q$.

Then:

$[k]G = s^{-1}H(M)\rho \; [+] \; s^{-1}r\rho x - a_3 q \; G =$

$[s^{-1}H(M)\rho]G + [s^{-1}r\rho][x]G - [a_3][q]G =$

$[u_1]G + [u_2]Q$.

On the other hand:

$[u_1]G + [u_2]Q = [s^{-1}H(M)\rho - a_1 q]G + [$

$s^{-1}r\rho - a_2 q][x]G = [s^{-1}H(M)\rho]G + [s^{-1}r\rho x]G -$

$[a_1 + a_2 x][q]G = [s^{-1}H(M)\rho + s^{-1}r\rho x]G =$

$= [s^{-1}(H(M)\rho + r\rho x)]G = [k]G$.

Thus, the algorithm correctness is proved.

6. THE ANALYSIS OF OUTCOMES

Crypto stability existing AEDS it is based on one of having computing complexities. In offered AEDS, its cryptographic firmness is based on several complexities: evaluations of a discrete taking the logarithm in a final field, solutions of a problem of expansion of enough big odd number to prime factors, realizations of addition operation of points of the elliptic curve set in a final field. It considerably raises crypto stabilities.

7. CONCLUSION

The idea of a design of offered algorithm allows modifying and raising crypto stabilities with adding of other computing complexities. It is intended for use in data reduction systems of different function at shaping and acknowledgement of authenticity of an electronic digital subscript.

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Opportunities for Students to Participate in the Program for Obtaining a Second European Diploma in Terms of COVID-19

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Abstract. In the context of the COVID-19 pandemic, the mobility of students and teachers, in particular international mobility, has changed dramatically. Many had to cancel the planned trips abroad, and even trips within the same country became difficult. Moreover, many students and applicants who could be included in the program of international mobility have big doubts and even completely exclude the desire to get acquainted with such opportunities and plan something similar for the future due to uncertainty about the feasibility of such trips. However, life goes on, opportunities gradually return, and given the fact that the process of entering such programs takes a lot of time, it is possible and necessary to join the process now. This article reveals some of the possibilities for international mobility planned for the coming period, including the 2020-2021 academic year and the next 2021-2022 academic year. The authors have long successful experience in organizing international educational mobility of students in the areas of Mechatronics, Automation, Management in Technical Systems, and Smart City Technology and the Internet of Things. International mobility programs affect European universities from Bulgaria, the Czech Republic, Germany, Greece, Latvia, and universities from Mongolia and Kazakhstan also participate in these programs. These programs are funded and funded by the Erasmus + and TEMPUS international foundations, and DAAD support is also possible. For a student, these programs are attractive not only with the opportunity to go to a foreign university, but also with the opportunity to get unique experience of studying at a European university in English or in the language of the state where the university is located, use of infrastructure and advanced technologies and educational equipment, and the opportunity to receive an international diploma, which is accepted without nostrification in all the leading countries of Europe, America, Australia.

Key words: double diploma, automation, smart city, smart home, automation, mechatronics, mobility, computer science, computer technology

INTRODUCTION

The double diploma program, which would more correctly be called the "program for two diplomas during one term of study", is an excellent opportunity for students. It is easiest to implement within the framework of the master's curriculum, since this is the most universal type of higher education. In various countries, graduate studies (in European countries it is called a master's degree program, which was previously translated into Russian as a "candidate of science", but this is a mistake), this program lasts from three to four semesters.

The essence of such a program is that a student can take one part of the training at the university of his country, the other (usually equal) part at any foreign university, and eventually receive diplomas from both universities.

Everything in reality is far from so simple, because this requires, firstly, synchronization of training programs, secondly, a legal opportunity for such a procedure, which is given by the conclusion of a number of necessary agreements between these universities, and thirdly, the necessary funding for travel and accommodation fourthly, knowledge of the language in which teaching will be conducted, fifthly, undergoing the selection procedure for applicants, sixthly, drawing up the necessary

documents, seventhly, obtaining a lengthy student visa, eighthly, enrolling in a second university, in - ninth, successful studies at a foreign university; and tenth, defense of master's theses, similar to graduation qualification work.

This list seems very long and very complicated, but practice has shown that, if desired, almost 100% of applicants cope with the task successfully at the highest level, that is, the defense of diploma work at both universities on time. A small percentage of relative failures is a small delay in defense at one of the universities, which can only be regarded as a small non-fatal difficulty, since the delay is provided enough, and if desired, the student can quite successfully defend his master's thesis in the new term.

The advantages of this method of obtaining education are many, the disadvantages are not known to us, except, perhaps, the need to pay a little more attention to the study of a foreign language and the practice of speaking it, as a rule, it is English, which has established itself as the language of international communication in all areas of science, technology and technology (even in biology and medicine, where the Latin language remained only for the names of plants, animals and medicines).

But, firstly, if a student has already chosen a technical specialty as a base for future production activities, then refusing to study English profoundly is illogical. Most of the most important literature on any technical specialty is published and widely available primarily in English. It is impossible to keep abreast of the modern element base in electronics, micro-electromechanical modules, sensors, actuators, other elements and devices of automation and computer technology without sufficient knowledge of the English language. Secondly, it is impossible not to have the ability to learn a foreign language, you can only do or not do it. If small children cope with learning a language without the help of dictionaries and automatic translators, just listening and memorizing, then a reasonable adult can sufficiently master the language, for this there are many modern techniques, the main of which are reading, speaking, listening, watching, repeating and, as a result, remember. Thirdly, let us recall the famous aphorism that a person is as many times a person as he knows foreign languages (attributed to Karl the Fifth), or less well-known: "He who does not know foreign languages has no idea about his own." (I.V. Goethe).

1. ESSENCE OF THE DOUBLE DIPLOMA PROGRAM

The main idea of the program is to provide the student with the opportunity to receive two diplomas as a result of one term of study. This seems impossible, since training in only one university gives only one diploma in the end, to obtain a second diploma, it would seem, training in a second university once again over the same period.

However, there are, for example, programs of the second higher education based on the first. In this case, the student studies only those subjects that were not in the list of subjects already studied by him for the first term of study. If, for example, a student has already studied mathematical statistics, and in his first diploma there is a positive mark for this subject, then instead of re-studying the same subject, he can be given a re-reading of this subject. This is possible provided that the university where the student receives a second higher education recognizes the results of the first higher education. There is no reason for non-recognition, since the formal accreditation of the quality of education is the state accreditation of higher education organizations.

Imagine that with this approach, all available items coincide. Then, it would seem, it turns out that to obtain a second diploma, it is enough to simply present the first diploma. But in practice this, of course, is impossible. But if two universities have agreed that they open a double diploma program, then students have the opportunity to enter such a program. In this case, in the first year a student is studying at a university in his homeland, in the second year he enters a foreign partner university without being expelled from the first university. He physically moves to this university, that is, moves to the city where this university is located for the duration of his studies, and attends the university on an equal basis with other students of this university. At the end of his studies, he defends the theses at this foreign university, receives a diploma there, after which he returns to the university where he received his first-year education, and defends his master's thesis there, after which he also receives a diploma from this university.

It turns out to be much easier for a student than for universities, since the student does not face the formal difficulties that the administrations of these two universities have solved for him. Therefore, there are not many such programs, and it is not so easy for a student to find such a program according to their professional interests, and if he is lucky and there is such a program, it is unreasonable to miss such an opportunity.

2. WHAT IS REQUIRED FROM UNIVERSITIES?

It is required for the implementation of such programs, first of all, the formal equivalence of the curricula of two curricula of different universities, despite the fact that each country has its own educational standards, which in some cases differ so dramatically that, at first glance, it is impossible to draw up such a curriculum , which would comply simultaneously with the standards of these two states.

The mechanism of program synchronization is rather complicated; it is described in our other publications in sufficient detail [1–6].

It is necessary that all subjects that should be studied according to the curriculum of a European university, be studied also according to the plan of a domestic university and vice versa. At the same time, the volume of the training load cannot be increased,

but it is also impossible to do without it, since some subjects cannot be recognized as identical or replaced with identical ones. The curriculum of the technical areas of training according to the educational standards of the Russian Federation requires the presence of non-technical subjects, such as a foreign language, the basics of psychology, and so on. No non-technical subjects are usually present in the curriculum of European universities. Therefore, those subjects that do not fit simultaneously in both curricula, the student must master as optional. In any case, each of the two curricula must be fully implemented, and practice has shown that this is possible.

Universities are required to recognize the legal equivalence of those subjects that are truly equivalent, to include in the list of elective subjects those that are mandatory at the partner university, and difficult decisions in all other subjects that do not fit into this scheme.

3. FEATURES OF THE SITUATION IN THE CONDITIONS OF A PANDEMIA

As a result of the pandemic, almost all countries closed their borders. Trips of students and teachers became impossible, in some cases they even had to hand in tickets, some expenses that were irrevocable, became the net losses of participants in such programs.

In this situation, the importance of distance education methods and the use of online educational programs has grown.

The learning process consists in the transfer of knowledge from teachers to students, in the control of their assimilation, in the student's practical work, in the final qualification work. The transmission of information may well be carried out by remote methods. Knowledge control is remotely more difficult, but possible. Remote hands-on labs are even more complex. Final qualification work can be formally performed remotely, but most European universities do not recognize this method due to the peculiarities of the organization of the educational process in them.

Since almost all universities of all countries switched to distance learning in March-June 2020, there are significant differences in the educational opportunities of students who are present in the city where the university is located and those students who are in another city and even in another country, almost no left.

Namely, let us consider, for example, how the situation developed at the Technical University of Liberec.

Here, the first wave of coronavirus was mitigated by stringent conditions, including the closure of the university and work at home (March - May 2020). In March, students were invited to go home.

The following software tools and products were implemented in distance learning:

a) The educational portal of the university elearning.tul.cz (Moodle is supplemented by connecting to the IS / Stag information system, presentations of individual lectures are available).

b) Streaming lecture system; Stream lectures on each subject are available to students.

c) Google Meet,

d) Google Clasroom,

d) Zoom,

f) Individual contact with students to solve some problems at the end of the semester.

During this busy time, students were not allowed into classes and laboratories. The entire campus was quarantined.

After the first graduation, students of past years could come to the laboratory individually, but they had to meet the following conditions:

a) contact your supervisor (to open the building and laboratory),

b) sign written statements stating that they have no symptoms of the disease or are not in quarantine;

c) to disinfect hands at the entrance to the laboratory / classroom where the exam was held,

d) use a mask and keep at least 2 m.

Mandatory wearing of masks was introduced inside university buildings (including the university cafeteria), in public buildings, shops and in public transport (see Fig. 1).

After the end of the first wave, when a new stage began (the university buildings opened), the rules boiled down to the following:

a) students must sign written statements that they do not have symptoms of the disease or are not in quarantine,

b) it is necessary to disinfect the hands at the entrance to the class where the exam was held,

c) it is necessary to use a mask and keep at a distance of at least 2 m.

Mandatory wearing of masks remained inside university buildings (including the university cafeteria), in public buildings, shops and in public transport.

Borders with individual EU countries have been relaxed, where the situation is similar to the situation in the Czech Republic.

Traveling to countries with a very high prevalence of coronavirus remained impossible.

In Germany, those students who managed to arrive (from the Gagarin Yu.A. Saratov State Technical University) studied remotely while in student dormitories, and those who had to return tickets because flights were canceled (from Novosibirsk State Technical University) were also trained in distance form, but from Novosibirsk.

Theoretically, it is not very important where the student is studying from if he is distance from the university. However, the legal difference is big. Students who are full-time, only part of their studies spent in the distance mode, while those who could not get to the European University, did not legalize their studies at the proper level.

Fortunately for them, they still have two semesters ahead of them, during which they get a chance to come to the university and carry out the

necessary amount of full-time education as soon as the quarantine is canceled and the borders open.

If these were second-year students, then training would also be possible for them, but formally it would not be training under the double diploma program, but training according to the second higher education scheme on the basis of the first higher education already available. The difference, it would seem, is small, but the help from universities in which primary education is carried out can no longer be received in the same amount for some formal reasons. First of all, a university can promote student mobility, pay a scholarship and pay some expenses on a competitive basis or from existing grants, especially if there is a grant specifically for organizing such mobility. But after formal protection and obtaining a diploma, a student ceases to be a student, therefore, such assistance cannot be provided to him.

Fig. 1. Laboratory work in TUL during quarantine. Dynamic measurement of piezoelectric coefficient

Another possibility in this case is admission to graduate school, but a person studying at the graduate school of one university, apparently, cannot simultaneously study at the magistracy of another university, and there is not much sense in this. In this case, it seems more appropriate to try to enter the graduate school of this European university, but this is a completely different form of educational mobility, the discussion of which is beyond the scope of this article.

4. PROSPECTS FOR THE DOUBLE DIPLOMA PROGRAM IN THE 2020-2021 ACADEMIC YEAR

Currently, students and teachers are concerned about the prospects of teaching students a double diploma program in the upcoming school year, which will begin in September this year and end next summer.

The technical universities of Novosibirsk and Saratov offer students a unique opportunity to study under the master's program of double diploma with the Technical University of Chemnitz (Germany) in the direction of "Smart city technology and the Internet of things". Under this project, students have the opportunity to study for the first year in one of these Russian universities, and the second year should be studied in Germany, at the Technical University of Chemnitz. These technologies are very relevant [8–9].

In addition, NSTU continues its joint program with the Technical University of Liberec (TUL) in the field of "Automation and Mechatronics" [4–7]. Within the framework of this program, which began as TEMPUS-MPAM [5] and continues with the support of the Erasmus + Foundation, NSTU sends almost two to three students to TUL almost every year for 9 months, and the program pays for travel and accommodation according to established quotas and rules. The success of education under this program is approaching 100%, namely, for the entire period only one student did not have time to defend the theses in a European university in a timely manner, which is to some extent due to additional difficulties in a pandemic, since the work was supposed to be mostly practical, but this student was completely successfully completed the rest of the educational program, so he retains the ability to successfully defend within the time frame set for this case. This student successfully defended his master's thesis at NSTU, "excellent", so at least he did not lose anything from his participation in the program, and all opportunities are fully preserved. All other students with a total of more than a dozen successfully defended their master's theses at both universities with excellent marks, and approximately half of them entered the graduate school of TUL.

5. ADVANTAGES OF THE CURRENT SITUATION

In contrast to the situation of previous years, students oriented to the double diploma program between NSTU and TUL have an additional advantage. It consists in the fact that it is already known that the indicated mobility in the upcoming school year will be supported by the ERASMUS program. Previously, students had to participate in the competitive selection and draw up documents without confidence in receiving funding, since information on receiving support appeared only in early June, while paperwork should begin in February-March in order to get a long-term visa and all other documents. Now, for them to participate in this program, it is enough to enroll in a master's program in "Management in Technical Systems" at the Faculty of Automation and Computer Engineering at NSTU, and pass a competitive selection at the end of winter 2020, where academic performance and knowledge of the English language are checked. In the SSTU named after Gagarin Yu.A. The program is being implemented in the direction of "Information Systems and Technologies". Recall that the Erasmus + Foundation pays for travel and provides scholarships for the period of study at a European university [10].

6. SELECTION OF STUDENTS FOR PARTICIPATION IN THE PROGRAM

Students are selected for participation in the Smart City program [11] by interviewing teachers with applicants, see Fig. 2–4.

Fig. 2. Interview with a student in the selection for participation in the double diploma program
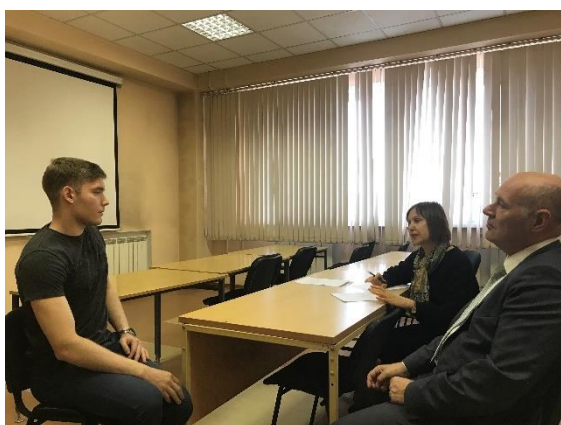
Fig. 3. Interview with a student in the selection for participation in the double diploma program (continued)

Fig. 4. Interview with a student in the selection for participation in the double diploma program (continued)

Questions are asked in English; answers should also be in English. It should be understood that, along with the opportunity to answer questions in the professional field, it is necessary to be able to conduct a normal household conversation, since this is necessary for successful temporary integration into the European community, which is necessary for successful training. Indeed, a person with sufficient knowledge of the English language in Europe is pretty comfortable everywhere.

As part of the program [11], the project participants prepared a series of textbooks in English that are designed according to a single template (see Fig. 5-6), each of the project participants sending their students to European universities (six universities) prepared three of these textbooks, the total number is thus eighteen. All these textbooks are placed in a hybrid educational space created by NSTU.

Fig. 5. Textbooks in English written in the framework of the double diploma program "Technologies of a smart city and the Internet of things"
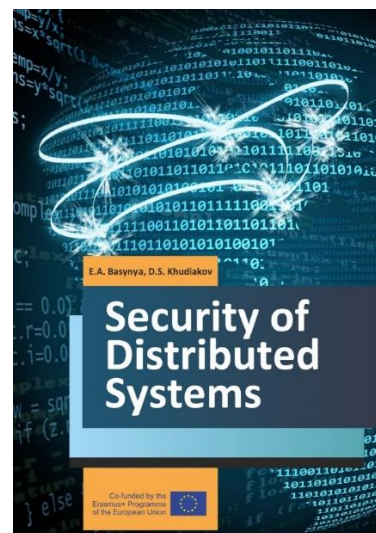
Fig. 6. Textbooks in English written in the framework of the double diploma program "Technologies of a smart city and the Internet of things"

7. DISCUSSION AND CONCLUSIONS

The mobility of students and teachers temporarily ceased due to the pandemic; however, this is not a cause for gloom. Much can be done remotely, in the very near future you can hope to open the borders and to resume double degree

programs, so you should not waste time while you can use it to improve your knowledge of the English language, to improve academic performance in important subjects and to prepare documents.

One of the important aspects of student selection is his motivation, that is, the ability to explain why he wants to participate in this program. As a rule, arguments indicate a desire to receive a high-quality education, an interest in the possibility of integration into the international scientific and technical community, a desire to get acquainted with the cultural achievements of foreign countries, to get to know people better, and so on. Generally, these guidelines can be called humanitarian and professional values.

Despite the fact that the generalized term "student" is used in the text of this article, one should not make the erroneous conclusion that only young men are selected to participate in the program. There are no differences in gender or other characteristics during selection, as well as on the basis of nationality, race, and others that have no relation to the opportunities and desire to learn. In Russian-language literature, it is not customary to be derogated, therefore it is not customary to apologize for various terms, since there is nothing to apologize to anyone who has not violated the rules of respect and correctness. Russia is the successor of the USSR, in which respect for all the peoples of the world and the equality of all sexes were spelled out in the Constitution. The fact that only young men were selected to participate in the program in 2020 is random; this is an ordinary manifestation of statistics in particular cases. We with the same desire will send students to study in this program, the program is open to all comers who have successfully mastered the curriculum and have sufficient knowledge of the English language.

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Design of PID-Regulators for Third-Order Objects with Delay: Comparison of Altair Embed and SimInTech Software

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Abstract. The article set out the task of comparing two software products for the automated design of controllers by the method of numerical optimization, but for reasons understandable from the context of the article, the comparison did not work out correctly. It was assumed that the comparison is carried out on the example of two typical problems, namely: problems of designing a controller for a third-order plant with delay, provided that there is or is not a free term in the denominator of the transfer function. Such objects have fundamentally different responses to a step jump; therefore, all tabular methods will give fundamentally different methods for a problem with a nonzero intercept, but they are not applicable to a problem with a nonzero intercept. Numerical optimization methods have an inherent advantage over tabular methods. This article does not make comparisons with MATLAB because such comparisons have been made before. The SimInTech software product was recently announced by NSTU by representatives of the developer, it has many initial advantages, such as complete openness of the code, which allows the user to easily create new and fairly complex object models, and a large bank of object models is also a significant advantage. Optimization software is also available in this software product. This article discusses some of the problems reported by the company that developed and distributes the second of these software, and speculates about the causes of these problems.

Key words: Automation, cybernetics, controller, PID, controller, optimization, numerical simulation, numerical optimization, VisSim, Altair Embed, SimInTech

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Optoelectronic Method for Determining the Physicochemical Composition of Liquids

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Abstract: Currently, optoelectronic sensors which are based on anomalous photo-voltage (APV) curtains derived from semiconductor compounds are attracting the attention of many experts. The use of APV receivers to determine the physicochemical composition of liquids, especially in the optoelectronic method, is considered to be one of the promising methods. If APV receiver is used as the first converter in optoelectronic systems, it allows to increase the efficiency of a number of parameters of the system, such as energy saving, reliability, speed, accuracy.

Keywords: APV receiver, Lambert-Behr, optoelectronics, diode.

INTRODUCTION

In optoelectronic devices which are based on a light source and a receiver, the APV receiver is used as the primary element that converts optical signals into electrical signals. The resulting electrical signal is registered in the form of voltage or enters the electronic circuit, separates and processes the specified parameters and transmits information about the measured quantity to the computer. Thus, the changed signal falls on the computing device, which is graded by the measured quantities [1-4].
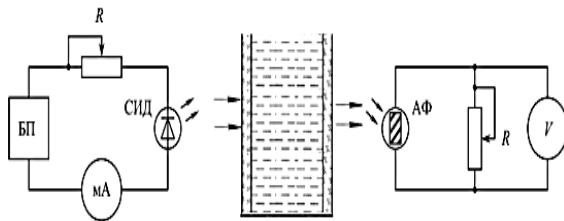

Fig. 1. Physicochemical analysis of liquids using APV-receiver content determination method

To check the colour of the liquids, the object being examined is irradiated with a light flux of two wavelengths λ_1 (green) and λ_2 (red).

According to Lambert-Behr's law, the luminous flux of wavelengths λ_1 and λ_2 passing through the layer of liquid under test is as follows:

$$\Phi_{\lambda_I} = \Phi_{0\,\lambda_I} e^{-k_I d}; \qquad (1)$$

$$\Phi_{\lambda_2} = \Phi_{0\,\lambda_2} e^{-(k_1+k_2)d} = \\ = \Phi_{0\,\lambda_2} e^{-k_1 d} + \Phi_{0\,\lambda_2} e^{-k_2 d} \qquad (2)$$

$\Phi_{0\lambda_1}, \Phi_{0\lambda_2}$ - the flux of light coming from the emitting diodes, k_1 - absorption coefficient; k_2 - colour absorption coefficient; d – the thickness of the liquid layer that is being tested. Equalizing the initial light fluxes $\Phi_{0\lambda_1} = \Phi_{0\lambda_2}$, we create:

$$\frac{\Phi_{\lambda_1}}{\Phi_{\lambda_2}} = \frac{\Phi_{0\lambda_1} \cdot e^{-k_1 d}}{\Phi_{0\lambda_1} \cdot e^{-k_1 d} \cdot e^{-k_2 d}} = e^{k_2 d} \qquad (3)$$

It can be seen from this expression that when d - constant, the given light fluxes λ_1 and λ_2 are proportional to the colour of the controlled substance. Using the developed compositional scheme, the device automatically controls ambient colour of the liquid.

The role of optoelectronic devices in production is related to a number of requirements for them in providing information about the physicochemical parameters of products and technological processes: wireless control, high sensitivity and accuracy, speed, small volume, simplicity and reliability.

The essence of optoelectronic control is that any substance emits, absorbs or reflects light. Therefore, the physicochemical composition of a substance and the quantitative ratio of its constituent elements depend on changes in illumination, light absorption, angle of rotation, and other properties of light interaction with matter [3].

1. MATHEMATICAL CALCULATION APV

If we look at the mathematical model of the APV receiver, it is a multi-variable function, and this function is expressed in terms of light flux Φ, spectral composition of optical radiation L, temperature T and humidity B:

$$U_\Phi = f(\Phi, T, L, B). \qquad (4)$$

Coefficient of variation in optical radiation of light sources (emitting diode, laser diode) of APV receivers:

$$K = \frac{\int_0^\infty \varphi_{e.\lambda}(\lambda) S_{\text{отн}}(\lambda) d\lambda}{\int_0^\infty \varphi_{e.\lambda}(\lambda) d\lambda}. \qquad (5)$$

Here $\varphi_{e.\lambda}(\lambda)$ is the relative scattering spectrum of the light flux emanating from the source; $S_{\text{отн}}(\lambda)$ is the

relative spectral characteristic of the APV receiver sensitivity.

Spectral relationship of light flux with the integral sensitivity of the APV receiver:

$$S_{\text{инт}\Phi e} = S_{\lambda.\Phi e.max}\, K. \tag{6}$$

Here $S_{\lambda.\Phi e.max}$ – the maximum spectral sensitivity of the APV receiver to light flux

Relative spectral sensitivity of APV receiver:

$$S_{\lambda.\text{отн}} = S_{\lambda.\text{абс}} / S_{\lambda.max}\,, \tag{7}$$

$S_{\lambda.\text{абс}}$ - absolute spectral sensitivity of the APV receiver; $S_{\lambda.max}$ - maximum spectral sensitivity of the APV receiver.

Sensitivity of the APV receiver to the initial frequency:

$$\Phi_n = \frac{S_{\text{отн}}(\lambda)}{S_{\frac{I}{\text{инт}}}} = \frac{U_{\text{ш}}}{U_{u.\text{инт}}}, \tag{8}$$

Here $U_{\text{ш}}$ – noise voltage; $S_{I.\text{инт}}$, $S_{u.\text{инт}}$ – current and voltage integral sensitivity of APV receiver.

Initial comparative sensitivity of the APV receiver:

$$\Phi_n^{*} = \Phi_n\sqrt{A\Delta f} = \Phi_{n.I}\sqrt{A}. \tag{9}$$

Here $\Phi_{n.I}$ – APV receiver's initial unit frequency bandwidth sensitivity; A – surface of the APV receiver; Δf – the frequency bandwidth of the amplified field.

The proposed frequency bandwidth for the measured area in the APV photoreceptor certification:

$$\Delta f = 0{,}2\, f_{\text{м}}\,. \tag{10}$$

Here $f_{\text{м}}$ – frequency modulation in certification.

The comparative detection capability of the APV receiver:

$$D^{*} = \frac{1}{\Phi_n^{*}}, \tag{11}$$

Here Φ_n^{*} – initial comparative specific sensitivity of the APV receiver.

Recalculation of the spectral sensitivity of the APV receiver to the light flux to the spectral sensitivity to the radiation flux:

$$S_{\lambda.\Phi e} = S_{\lambda.\Phi v}\, K_{max}\, V(\lambda), \tag{12}$$

Here $S_{\lambda.\Phi e}$, $S_{\lambda.\Phi v}$ – spectral sensitivity to radiation flux and light flux; ; K_{max} – spectral maximum efficiency of monochromatic radiation; $V(\lambda)$ – spectral relative light efficiency of monochromatic radiation for daylight (*Table* 1).

Recalculation of the parameters of the APV receiver in the given light PMD (photometric dimension), in the energy PMD parameters:

$$S_{\text{инт}.\Phi e} = S_{\text{инт}.\Phi v}\, K_{max}\, k_{\text{г}}; \tag{13}$$

$$\Phi_{n.e} = \frac{\Phi_{n.v}}{K_{max} k_{\text{г}}},\ Bm, \tag{14}$$

Here $S_{\text{инт}.\Phi e}$, $S_{\text{инт}.\Phi v}$ – integral sensitivity of APV receiver to light flux and radiation flux; $k_{\text{г}}$ – the coefficient of radiation used by vision; $\Phi_{n.e}$, $\Phi_{n.v}$ – The initial sensitivity of the APV receiver to energy and light PMD at a given line frequency [2].

Table 1

Spectral relative light efficiency for day vision of monochromatic radiation

λ, nm	300	400	500	600	700
0	-	0.00	0.32	0.63	0.0041
10	-	4	3	1	0021
20	-	0012	503	503	00105
30	-	0040	710	381	00052
40	-	0116	862	265	00025
50	-	023	954	175	00012
60	-	038	995	107	00006
70	-	060	995	061	00003
80	0.00003	091	952	032	00001
90	9	139	870	017	0
	0.00012	208	757	0082	-

Recalculation of the parameters of the APV receiver given in energy PMDs for one source of radiation to the parameters in energy PMDs for another source of radiation:

$$S_{\text{инт}.\Phi e}^{''} = \frac{S_{\text{инт}.\Phi v}^{'} K^{''}}{k'}; \tag{15}$$

$$\Phi_{n.\Phi e}^{''} = \frac{\Phi_{n.\Phi v}^{'} K^{''}}{k^{''}}, \tag{16}$$

Here $S_{\text{инт}.\Phi v}^{'}$, $S_{\text{инт}.\Phi e}^{''}$ – integral sensitivity of the APV receiver to the radiation flux for the first and second source radiation; $\Phi_{n.\Phi v}^{'}$, $\Phi_{n.\Phi e}^{''}$ – initial sensitivity of the PMD receiver to the frequency bandwidth at the given energy PMD for the first and second source.

Correlation of APV receiver sensitivity to voltage and current:

$$S_U \approx S_I R_{\text{н}}\,, \tag{17}$$

Here $R_{\text{н}}$ – load resistance.

$$U_\Phi \approx S_I\, \Phi\,, \tag{18}$$

Here S_I - APV receiver sensitivity.

Voltage photo signal of APV receiver:

$$U_c = S_U\, \Phi\,, \tag{19}$$

Here S_U - voltage sensitivity of the APV receiver [2-5].

CONCLUSION

In summary, APV receivers for optoelectronic systems can be used to measure the parameters of non-electrical quantities in control-measurement techniques, such as density, thickness, humidity, coordinate of a moving object, colour, concentration, surface level, and so on. The use of APV receivers in optoelectronic systems as autonomous optical light receivers is promising in the areas of the field.

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Study of the Effectiveness of the Use of a Mobile Microprocessor in Robotics

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Abstract: The article gives an overview of the current state of robotics and assesses the potential effectiveness of using a mobile microprocessor in robotics. Any publications on this topic quickly become obsolete, as a result of which relatively few scientific reviews and publications are written on this topic, the main information is on the network, where updates are not every week or month, but almost every hour. At the same time, there are fake publications, it is difficult for a specialist, especially a student, to distinguish reliable knowledge from fake. In addition, on the Internet there is a reproduction of identical texts, especially on portals that are created for commercial purposes for unscrupulous students, graduate students and even researchers and teachers. These portals offer reviews on a relevant topic, which are often themselves made from other reviews using the "glue and scissors" method, or what is now called "copy-paste". This review does not pretend to be original, but it was not written using the "glue and scissors" method, but by studying current information, analyzing it and writing on its basis its own text with its own opinions and conclusions, although this still remains a review, that is, in This article does not solve a new scientific problem and does not describe the unique results of experiments or scientific research by the author. This publication is of educational importance, it is addressed to undergraduate and postgraduate students with the aim of a more substantive professional orientation in the field of robotics and microprocessor technology.

Key words: Robotics, automation, control systems, microprocessors, microcontrollers, regulators

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Investigation of the Accuracy of Photogrammetry as a Method for Determining the Volume of an Object

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Abstract. This article describes the results of a practical study of the photogrammetry method to determine the volume of objects caught in the focus of the camera. This task is one of the tasks of technical vision for robotics. A number of practical tasks for robots can be associated with the determination of volume, for example, during ore mining, during refueling, when cleaning the area from debris, snow, etc. There are also a number of specific tasks where volume determination is required with great accuracy. The photogrammetry method allows you to estimate the volume from the image of the object, taking into account the method of determining distances and distances, this method is not traditionally expected to be very accurate. However, it is of great interest to determine the potential accuracy of this method, since the development of computer technology and the growth of software capabilities give new life to many methods that were not widely used before due to the large amount of necessary calculations, but now this restriction has been removed from almost any problem, because first, the intelligence on board any robot, even the smallest one, is many times higher than it was before, and secondly, almost any robot has the ability to communicate with the base central processor, so it can potentially use the services of a fairly large data center, just send a task and get a ready answer.

Key words: technical vision, robotics, photogrammetry, video, photos, images, calculations, modeling, experiment

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Regulator Design for Multidimensional Objects of the Second Order with Delay by Numerical Optimization

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Abstract: Designing regulators for single-channel systems in the twenty-first century is no longer a difficult problem. Existing methods for their calculation by numerical optimization make it possible to relatively easily solve a substantial part of the problems, the solution of which was previously devoted to a lot of scientific articles, textbooks, monographs. Some of these tasks remained unsolved, which is associated with the specific features of the object models. Objects with many inputs and many outputs, called multichannel or multidimensional, and in the English language literature MIMO - Many Inputs Many Outputs - still pose a certain problem. Such problems are also solved in some cases by numerical optimization, but a systematic presentation of the methods for solving this problem is not enough in the literature. This article attempts to systematize the methodology for solving this problem with one example, which is of sufficient complexity due to the fact that in the matrix transfer function of the object, each element is a second-order link with a delay element. The application of the method of numerical optimization directly, without any preliminary analytical actions, did not lead to the desired result, therefore, some special methods were used, which are recommended for solving such problems.

Key words: mathematical modeling, regulators, controllers, PID, multichannel systems, MIMO, stability, accuracy, control in technical systems, automation, cybernetics, numerical simulation, optimization

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International IEEE Siberian Conference on Control and Communications SIBCON-2021 and the Future of Conferences on Automatics

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Abstract: In 2020, the scientific community has found an unique experience in organizing and holding conferences in a pandemic. A problem of influence of the pandemy to the scientific meetings is considered in many papers under different viewpoints. Experts do not have common opinion related of returning to situation before 2020 or virtual conferences will become dominant. The author trust that amount of the international events with the publication of papers in the scientific databases will increase despite all advantages of virtual meetings and invites to the IEEE-Siberian Conference on Control and Communications SIBCON-2021.

Keywords: quality of conference, management of conference, communication, robotics, Internet of things, virtual conference

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Testing as a Method of Remote Learning in Connection with the COVID-19 Pandemic: Effective Feedback on the Level of Students' Knowledge

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Abstract. In the context of self-isolation announced in connection with the COVID-19 pandemic, the ability of teachers to contact teaching methods has changed significantly, including lecturing, conducting practical exercises and laboratory work. Only the possibilities of assigning assignments that students can do on their own have not been affected, since nothing prevents you from assigning assignments and checking the results using any of the communication technologies, starting with email, ending with any means of communication, including conferences and webinars. Methods involving direct dialogs are currently not effective enough, because providing all teachers and students with stable Internet connection in our country still remains a problem. Many systems work stably only with a relatively small number of active interlocutors. In this situation, testing, which, as a rule, teachers actively object, becomes a fairly effective teaching method, providing feedback on the level of students' knowledge. This article informs readers about the experience of applying testing in the subject "Modeling of control systems".

Key words: automation, mathematical modeling, numerical optimization, cybernetics, distance education, network education, testing, automatic control, control in technical systems, higher technical education

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A Paradox without Paradox: Physical Laws Are Still Unshakable

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Abstract. A recent report claims that a new physical paradox has been discovered, "the essence of which is the possibility of increasing the amplitude of mechanical vibrations of an object without external influence" [1]. The article briefly explains why this phenomenon cannot be called a paradox, and why this new information does not overwhelm the foundations of traditional theoretical physics. This article is not a refutation of the terminology of a journalist article, it is a discussion on a scientific topic with people of science, since this publication refers to the opinion of the "Scientific Group led by corresponding member of the RAS Anton Krivtsov". Probably, journalists could introduce their own distortions into the original text, which, unfortunately, happens, however, the scientific publications of this collective are apparently read by a much smaller number of people than populist messages, so some brief comments are necessary not only to maintain the level of scientific discussions on This topic, but also to protect students from an opinion that is already becoming commonplace, consists in the fact that nothing can be known reliably in science, since any knowledge with its development is not only clarified, but also completely refuted. This article shows that, fortunately, this is not so.

Keywords: automation, feedbacks, cybernetics, dynamical system, stability, instability, resonance, oscillations, self-oscillations, damped oscillations, undamped oscillations, oscillatory instability

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