Controlling Systems for Robotics, Mechatronics and Laser Measurers: Concept of the Summer School

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***Abstract:* The paper announces the Summer School for students from European countries. In the paper, the association in the framework of a single training course is based on lectures on automation, mechatronics, robotics, metrology and laser physics. All these directions are connected by a single common theme of high-precision control, which requires high-precision fast-acting measurements, as well as information transformation, signal processing and the formation of control actions. The team of professors who formed the subject of the summer school and the content of the reports has a unique knowledge and experience in the areas where lectures and seminars will be conducted. The German DAAD Foundation undertook to pay eight students from Germany an organizational fee for participating in the summer school, as well as the costs of obtaining a visa and travel to and from the place of study. The organizational fee also covers accommodation and meals during the summer school. Students from all European countries are also invited. The language of the summer school is English.**

***Key words:* Control, automation, robotics, mechatronics, laser physics, metrology, fundamental metrology, measuring technology, biomedical instrument making**

INTRODUCTION

The topics of the proposed Summer School are relevant for the Master Diploma students directed to the researches in the field of leading edge of Automatics, Laser and optic techniques, Fundamental metrology, Robotics, Medical techniques, Information technology [78].

The teacher team is the leaders of the Science School of Professor Anatoly Vostrikov with him itself. The leased of the project and Prof. Olga Cherkasova are scientist from the Science School of Academician Sergey Bagayev. It gives the possibility to present the newest results of the both Science Schools.

The Department of Automation has good and fruitful experience of the collaboration with the many Professors from Germany, Czech, Bulgaria, France, Mongolia, India, China and other, which are members of editing board of Science Journal "Automation & Software Enginery" see URL: http://jurnal.nips.ru/en/node/20 . This collaboration takes place not only on the direction of the editing of the joint journal, but also in the science and higher education. This gives the opportunity to hope that it will be possible to collect the necessary group of the Master-degree students, who will take part in the Summer School.

In addition, we propose to invite some European Professors from this Editing Board to take part in the Summer School as invited Professor, at the expense of NSTU, Department of Automation. The list of the Germany Professors, who can help to select the students from Germany, is bellow.

The proposed Summer School will allow increasing the collaboration, broadening the directions of it in the form of joint supervising of the post-graduate student, joint education program on double-diploma master degree, and science researches in the common humanitarian goals, such as robotic prosthetic device, intellectual invalid carriage and so on.

Monograph [19] has been specially prepared for the Summer School. It is the second edition (and/or new special monograph) with necessary additions; it will be presented to each participant of the Summer School.

The preliminary topics of the lectures

1. Dynamics of mechatronic systems.
2. Classical and modern methods of the design of feedback loops.
3. Multi-channel feedback controlled systems.
4. Feedback control in real-time robotic systems.
5. The experience of using embedded Linux kernels as a core for industrial intelligent control system.
6. Computer vision systems in robotics.
7. Intellectual sensors and systems.
8. Identification of complex objects and processes.
9. Data acquisition systems in robotics.

10. Heuristic methods of control.
11. Numerical optimization of feedback-control systems.
12. Electronic systems in laser physics: newest achievement and concept of the future developing.
13. Controlling system for hipper-fine laser spectrometer.
14. Laser method of the investigation of spices of wildlife.
15. Characteristic responses of biological and nanoscale systems in the terahertz frequency range.
16. Methods of laser high-accuracy measuring of distances, shifts and velocity.
17. Digital signal processing.
18. High-speed processing of data flows in real time.
19. Basic metrology, optical frequency standard and controlling electronic systems for it.
20. Modern measurement techniques based on super-speed many-digits ADS.

1. DYNAMICS OF MECHATRONIC SYSTEMS

Mechatronic systems are systems that unite mechanical and electronic assemblies and elements that are linked together by such complex connections that it is impossible and inappropriate to treat them separately. Only joint examination of their action is fruinable. Mechatronic systems are very popular in robotics. In the early stages of technological development, the mechanical parts of the device were made separately, as a rule, by individual performers, or were taken as components; the electronic part was created specifically for the specified mechanical products, taking into account their properties. In this case, the mechanical part is most often not adjusted to the capabilities of the electronic part; it was unchanged after choosing a technical solution. If the mechanical part was made taking into account the capabilities of the electronic part, these were rare exceptions, such developments were piece-wise. In addition, the developers of the electronic part were also divided into hardware developers and software developers.

At present, this is almost never done. The product is developed and manufactured by a joint team of specialists in mechanics, electronics, programming, information technologies and other related fields, such as measuring technology, metrology, physics, chemistry, and so on. This allowed to more effectively connecting of electronic and mechanical parts, using space economically and achievement of better characteristics of such nodes. An example is the corner corner control unit, which includes both a stepping motor, and a reducer, and a circuit for controlling this stepper motor, and rotation angle sensors for determining the actual shaft rotation, and a circuit for correcting the angle of rotation from the measurement results. Similar products are also performed in a miniature form and are called Microelectronic Modular Systems (MEMS).

The management of such systems is carried out in order to achieve the required characteristics both in static and in dynamics, and ensuring high dynamic accuracy is more difficult. The section “Dynamics of mechatronic systems” is devoted to these problems and acquaints listeners with the main achievements in this field [1–3].

2. CLASSICAL AND MODERN METHODS OF THE DESIGN OF FEEDBACK LOOPS

Designing feedbacks is to select the structure of the regulator and calculate its parameters. This is done based on knowledge of the mathematical model of a managed object. If the regulator is not properly designed, the system may be unstable. Such a system, instead of implementing control, will swing the output parameters of the object near the prescribed values with increasing amplitude or output it far beyond the prescribed state. Previously, in practice, methods were used that made it possible, in a rather complicated way, to obtain, if not a good, then at least satisfactory calculation of the regulator. At present, such methods are no longer used. The quality of management, which could be satisfied with the creation of fairly coarse systems, no longer satisfies anyone. Currently, control systems provide control of output values of the object with such high accuracy that is unattainable by any other methods, including manual control. Therefore, the development of design methods for regulators is extremely important. The most effective methods of calculation are based on advanced algorithms using information technology, and based on the most important mathematical relationships, which are rigorously proven and are tools of the theory of automatic control [4–15].

3. MULTI-CHANNEL FEEDBACK CONTROLLED SYSTEMS.

Many control objects have more than one output value, as well as the same number of inputs to change these output values. This allows you to control several output values of the object at the same time. However, this task is extremely complicated by the fact that each input affects each output, since in the mathematical model there are cross-links of mutual influence. Controlling one value invariably causes a change in all other output quantities. But it is required to provide an autopnous control of each output quantity, that is, an independent change of any of the output quantities in any direction by any increment value. Therefore, the regulator should contain simultaneously the same number of control circuits, which allows providing the required autonomy of control. If the object has N inputs and the same number of outputs, then the controller should have the same number of inputs and outputs, and it contains N^2 single-channel controllers that generate control signals from each input to each output, which is the input of the object.

A special section of the theory of automatic control, called "Design of multi-channel (multiply connected) control systems", deals with the solution of this problem [16–17].

4. FEEDBACK CONTROL IN REAL-TIME ROBOTIC SYSTEMS

Control with feedback in robotic systems is most relevant. Only in the loop with feedback can the control be accurate, since such a circuit suppresses the effect of external uncontrolled disturbances, which can be very significant. Real-time mode for digital systems means that the analysis of signals from sensors, the calculation and generation of control signals and their supply to actuators must be carried out so quickly that the delays of these processes do not affect the stability of the controlled objects in the required frequency band in any way. Also one of the features of modern robotics is the widespread use of wireless communication lines, which allows eliminating numerous cables connecting individual nodes of the system to each other. However, this adds speed problems, since the encoding and decoding of transmitted signals also should not add significant delays to the propagation path of the control signal. A series of lectures in the field of robotics in real time are devoted to these problems [18].

5. THE EXPERIENCE OF USING EMBEDDED LINUX KERNELS AS A CORE FOR INDUSTRIAL INTELLIGENT CONTROL SYSTEM

Industrial intellectual management systems are now extremely relevant. The *Linux* kernel is attractive because it is free software that is not required to be bought, its use can be done for free. At the same time, the use of free software products has its own peculiarities, since such products are not developed by a single performer for a specific task, but are developed by a multitude of developers, each of which solves its own problems and has its own goals. Therefore, some functions may not be sufficiently developed. However, this way of solving management problems is extremely promising. A lecture course on this topic introduces the peculiarities of this approach, with the difficulties encountered and methods for overcoming them [19].

6. COMPUTER VISION SYSTEMS IN ROBOTICS

Robotics is not only a mechanical change of some parts of a slab structure, but, above all, a controlled change in all parts of the device, taking into account the state of the environment, the movement of objects in it, and also taking into account the task set before the robotic device. Therefore, the real robot is, first of all, the most complicated system of sensors and measuring systems, and only then it is a system of executive devices, as well as software and hardware for the precise control of these changes. The most important and most informative part of information about the surrounding space is certainly contained in images, in visual information [1–3, 54].

7. INTELLECTUAL SENSORS AND SYSTEMS

The sensors of various physical quantities, as a rule, are based on the action of certain physical laws. Most sensors convert the measured values to electrical quantities, which are then transferred to the intelligent device to calculate the initial measured values. However, many sensor output signals can depend on many parameters, so this simplified approach may in some cases not correspond to the task. For example, if visual information is used to drive a car without human intervention, then an image of some obstacle can cause the car to change its trajectory so that it does not meet this obstacle. But many visual obstacles are not physical obstacles to the movement of the car, for example, a wind-up newspaper, or an empty cardboard box, or a plastic opaque package is impractical to go around if there is a firm belief that behind this ephemeral obstacle there is not a significant and not ephemeral obstacle for example, a brick under a cardboard box). An ordinary driver, as a rule, is guided by his own experience and intuition to distinguish a crumpled empty newspaper from a newspaper covering a large cobblestone. The robot driver should be guided by more reliable sources of information. For such purposes, it is best suited, for example, to use parallel sensors of several different types, for example, an ultrasonic sensor in addition to a video camera. There are other more complex examples where several sensors can be combined into an intelligent pattern recognition system, which is the subject of this lecture course [1–3].

8. IDENTIFICATION OF COMPLEX OBJECTS AND PROCESSES

The search for a mathematical description of the processes under study is called identification. Identification is also needed to determine the mathematical model of control objects, since, depending on the properties of this model, the controller for the control system of this object should be calculated. In the case of structural identification, the structure of the mathematical model of the object is determined, and for parametric identification, the values of the parameters of this model are determined. Of course, any identification contains errors. It is important to carry out identification in such a way that the errors contained in it do not affect the result of controlling the object. A particularly difficult task is the identification of complex objects consisting of many elements, connected by complex internal connections. Features of identifying complex objects are discussed in this course. The author team also developed algorithms for automatic identification of complex objects, the action of which can be shown on examples in real time [20–21].

9. DATA ACQUISITION SYSTEMS IN ROBOTICS

Data collection and processing systems have recently become particularly relevant. Here we are not talking about measuring the change in a single quantity, or even about several randomly changing quantities. In such systems, the number of simultaneously measured quantities and simultaneously processed data is extremely large. This task is also connected with the task of real-time image processing; in particular, group processing of satellite images to extract information from them that is not contained in any of the photographs separately. Such information can be obtained only after the implementation of a complex computational procedure. For example, when processing satellite photographs, you first need to recognize characteristic relief lines, for example, river lines. Then it is necessary to carry out reverse distortions, which eliminate the sparking of images caused by the non-perpendicularity of the axis of the photometric apparatus with respect to the photorefurable surface. Next, cut out the fragment of the image, which is of special interest and the method of maturation to bring it to the desired size. Such an operation should be done with all the images obtained separately, and such images, as a rule, are not less than four, in different ranges of visible and invisible radiation. After that, algebraic sums and differences of these images with different weight coefficients are calculated, which allows eliminating unnecessary information and emphasizing the most relevant information, for example, water supply, temperature distribution, and so on. About this and other similar methods of image processing tells this course [22].

10. HEURISTIC METHODS OF CONTROL

Heuristic management methods are based on various advanced algorithms. Among such algorithms, the genetic algorithm, neural network algorithm, Petri nets, algorithms of ant colonies, colonies of colonies, colonies of bacteria and many others are known. Most of these algorithms are oriented to using them to control many objects, the number of which sometimes exceeds many hundreds or even thousands. Some of these algorithms can also be used to control a small number of control quantities. The latest developments in this area are devoted to this course [23–24].

11. NUMERICAL OPTIMIZATION OF FEEDBACK-CONTROL SYSTEMS

The technique of numerical optimization of regulators for feedback is not widely known, but its effectiveness, taking into account the relevance of the problems solved with this technique, makes this course of lectures extremely important. The theory of automatic control offers a whole arsenal of means for anatilic calculation of regulators in the event that the mathematical model of the object is known with sufficient accuracy and if it is not too complicated. If the mathematical model of the object is complex, then analytical methods are either completely absent or so complex that their application is not correct, or not reliable. To objects for which analytical synthesis of regulators is practically impossible, one should include objects with nonlinear elements, especially with two or more nonlinear elements, as well as objects with delay, multiply connected objects and objects with distributed parameters. All these objects do not represent any complexity for the process of numerical optimization provided that software tools for modeling and optimization are available, and the methods and target functions for the optimization are available. All these conditions are now met; therefore the toolkit of numerical optimization of regulators has become the most effective tool for solving these problems. This course is devoted to this topic; it also gives examples of new regulator structures, some of which are patented [25–48].

12. ELECTRONIC SYSTEMS IN LASER PHYSICS: NEWEST ACHIEVEMENT AND CONCEPT OF THE FUTURE DEVELOPING

The newest achievements in the field of electronic control systems for laser radiation are revealed on examples of systems for stabilizing the frequency of a laser on a physical reference (an absorbing or bleaching cell), stabilizing the phase difference of two lasers, i.e. frequency binding of one laser to another, stabilization of laser radiation power, simultaneous power stabilization and radiation frequency. These subsystems are built on the principle of negative feedback, their main purpose - stabilization or management. In this section, the main functional diagrams of such subsystems are discussed, the physical principles of their operation are explained, the technical requirements for the electronic components of such subsystems are substantiated, the features of their functioning, methods of their calculation, design and debugging are revealed [49].

13. CONTROLLING SYSTEM FOR HIPPER-FINE LASER SPECTROMETER

A laser heterodyne frequency stabilization system with a hyperfine structure of absorption is also discussed, for example, the stabilization of a helium-neon laser along methane vapor absorption lines. This setup is also used as a spectrometer for the hyperfine structure of methane absorption lines. The refinement of the properties of the hyperfine structure of the spectrum makes it possible to increase the accuracy of the stabilization of the laser, and an increase in the accuracy of the stabilization of the laser makes it possible to investigate in more detail the hyperfine structure. Due to the digital control of the system, it can simultaneously perform both these functions. The system contains three lasers, one of which is previously stabilized in frequency without recognizing the hyperfine structure. This stabilization is carried out with high accuracy, but not with a record. The second laser is frequency-linked to the first laser to within a phase of the difference frequency. Namely: the difference frequency of two lasers, obtained by the heterodyning method, is connected by means of a phase-locked loop to the reference frequency by changing the frequency of the second laser. As a result, its frequency becomes equal to the frequency of the first laser with some fixed frequency addition, which is completely controllable. The third laser in the same way is frequency-related to the second laser, but the sign of the frequency additive is in this case opposite, so the frequency of the third laser is approximately equal to the frequency of the first laser, since both frequency additives are approximately equal to each other. Nevertheless, there is some small difference in these frequencies, which is programmed, which allows you to slowly rearrange the frequency of the third laser near the frequency of the first laser and keep it in this state for a long time. Such a scheme makes it possible to investigate in detail the hyperfine structure of the resonance absorption lines of methane near the frequency of laser radiation [49].

14. LASER METHOD OF THE INVESTIGATION OF SPICES OF WILDLIFE

Optical methods for studying samples of living nature have long been known. The use of an optical microscope made it possible to detect the cellular structure of living tissues. Laser methods make it possible to investigate the presence of certain atoms or molecules and to estimate the amount of these substances even in the case of their extremely low concentration. Even a few atoms of matter can be outgassed by their emission under the action of laser radiation, the frequency of which is specially selected for the detection of these atoms or molecules. These investigations belong to the field of spectroscopy of ultra-low concentrations of matter [59–77].

15. CHARACTERISTIC RESPONSES OF BIOLOGICAL AND NANOSCALE SYSTEMS IN THE TERAHERTZ FREQUENCY RANGE

Laser methods make it possible to study objects of living nature without destroying them. Some parameters of natural objects can not be determined by any other methods. This in particular refers to the analysis of hormones in the living body. Recently, femtosecond lasers have been used in this field, which makes the measurements extremely sensitive and unique in their accuracy and diagnostic capabilities. These methods can even monitor the difference in the hormonal state of the organism in various psychological states. It is also possible to track genetic changes in populations (as a rule, such studies are carried out on fruit flies). Studies of living nature with the help of laser methods belong to the most advanced edge of fundamental science [59–77].

16. METHODS OF LASER HIGH-ACCURACY MEASURING OF DISTANCES, SHIFTS AND VELOCITY

High-precision measurements of displacements, distances, vibrations, velocities and other characteristics can be carried out using laser methods. There are no more precise methods for such measurements at the moment. Laser radiation is both a model length standard and a means of forming measurement signals, which are then converted from optical to electrical, then into digital readings, and then the desired characteristics and parameters of movements, vibrations and displacements are determined by the method of stream processing of digital samples.

These methods are developed at the Institute of Laser Physics and have many fields of application, including measurements of ultra-small vibrations with various diagnostic purposes, measurements of ultra-small displacements and diagnostics of rock microvibrations in order to identify earthquake precursors in seismic zones and many other applications. This series of lectures is devoted to this direction [50–53].

17. DIGITAL SIGNAL PROCESSING

Digital signal processing is used in the measurement technique to isolate useful information from the received signal. In some cases, useful information is carried by frequency, amplitude or phase modulation, or other signal characteristics. In some cases, the information is concentrated in a pair of signals, for example, in a Hilbert pair, which is a coherent and quadrature signal, that is, the projection of the rotating signal on the abscissa and ordinate axes. Such signals should be processed together, because individually none of the signals contains such accurate information that is contained in this pair of signals together. The processing methods of such signals allow, for example, eliminating the influence of the offset of the zero operating point of the amplifier and the digital-to-analog converter, to eliminate the influence of amplitude modulation on the result of measuring frequency or phase modulation, and so on. Some original patented signal processing techniques for measuring phase and frequency differences are described in this course.

18. HIGH-SPEED PROCESSING OF DATA FLOWS IN REAL TIME

The processing of information flows is related to the problem that if the entire data stream is attempted to be written to some digital medium, then it will be extremely quickly filled, and then data will be written out nowhere. Therefore, stream processing should retrieve data as new signal samples arrive, and only the extracted information should be stored on the medium for subsequent secondary processing. For example, data can come in the form of a stream of paired 14-bit samples with a repetition rate of 120 MHz and higher. Of course, such a volume of data is impractical to first save, and only then process. It is not a good solution and thinning out the data, because it means the loss of valuable information, which may be irreplaceable. Therefore, stream processing is used for this purpose, which deals with a data stream that has practically no beginning and no end, and which is converted to a new stream with fewer bits, but no less useful information. This series of lectures is devoted to this direction [55–58].

19. BASIC METROLOGY, OPTICAL FREQUENCY STANDARD AND CONTROLLING ELECTRONIC SYSTEMS FOR IT

Fundamental metrology, in contrast to conventional metrology, is engaged in the creation of primary standards and measures. In particular, one of the topical areas of laser physics is the creation of laser frequency and length standards. This is necessary for high-precision measurements, especially in satellite navigation. Indeed, the problems of measuring distances in the global GLONASS or GPS satellite system are closely related to the problem of time measurement. The units of time (frequency) and length can be matched by a ratio according to the theory of constancy and time independence of the speed of light, as well as the propagation velocity of any electromagnetic radiation in a vacuum. Therefore, by measuring the lengths of time intervals, it is possible to measure distances in the presence of appropriate circuits that transform the distance into time intervals. The Advisory Committee on the definition of the meter formulated a recommendation according to which the magnitude of the speed of light is determined by the frequency of the laser emission on a helium-neon mixture stabilized by transitions in methane. Thus, the problem of measuring time intervals with high accuracy is urgent, and also the problem of increasing the accuracy of frequency formation serving as a standard of time. The solution of these problems requires the creation of precision high-speed frequency meters in time. These devices include, as an integral part, electronic stabilization and control systems that have been designed and built specifically for these purposes. These devices include electronic subsystems for stabilizing frequency, power, linking the phase difference to a reference oscillator, as well as the proper high-frequency stable generators, frequency synthesizers, temperature stabilizers, and many other devices. The peculiarity of such developments is that private technical requirements for subsystems should be developed on the basis of general requirements to the system as a whole, which requires rather complex analytical and experimental studies. These subsystems are of high precision, since the accuracy achieved in them is extremely high, the relative error lies in the range from 0.0001% or less for various systems, in some cases it does not exceed 0.000001%.

20. MODERN MEASUREMENT TECHNIQUES BASED ON SUPER-SPEED MANY-DIGITS ADS.

This course is thematically continuing the course on digital signal processing. It describes new methods for digitizing signals in which the main information component is frequency or phase modulation, and amplitude modulation is an interfering factor. By its statistical properties, the signal essentially resembles a narrowband random process, but its frequency and phase modulation are not random, but carry information about the measured motion parameters. The conversion of such a signal by means of a high-frequency analog-to-digital converter makes it possible to obtain in parallel several sequences at a difference frequency. In particular, it is possible to obtain the coherent and quadrature components of the signal, which makes it possible to perform frequency and phase measurements with record accuracy and a record wide frequency band. In laser physics, such measurement methods are extremely relevant, since they allow measurements of frequency instability with record accuracy, which in combination with methods for stabilizing the frequency of laser radiation from physical resonances makes it possible to create laser frequency standards that do not have world analogues.

21. DETAILED PROGRAM OF THE SUMMER SCHOOL

11/08/2018 – transfer from airport, registration of the participants, inauguration, free time, excursions and orientation

12/08/2018 – departure to Altay, accommodation, rest

13/08/2018 – 25/08/2018 – Summer school in Erlagol

25/08/2018 – departure from Altay to Novosibirsk, accommodation in Novosibirsk, rest, departure to airport.

11/08/2018, Saturday

Transfer from airport, registration of the participants, inauguration, free time, excursions and orientation

12/08/2018, Sunday

Departure to Altay (about 10-00), rest and dinner in village Srostki, arrival to Altay (about 16-00), accommodation, rest

13/08/2018, Monday

8-30 – 9-30 Breakfast

10-00 – 11-30. Prof. V.A. Zhmud (Russia), Prof. Hubert Roth (Germany). Basic problems of Controlling Systems for Robotics, Mechatronics and Laser Measurers.

11-30 – 13-00. Prof. A.S. Vostrikov, Prof. G.A. Fransuzova, Prof. Jaroslav Nosek (Czech Republic). Dynamics of mechatronic systems. Part 1.

13-30 – 14-30 – Lunch

15-00 – 16-30. Prof. A.S. Vostrikov, Prof. G.A. Fransuzova, Prof. Jaroslav Nosek (Czech

Republic). Dynamics of mechatronic systems. Part 2.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

14/08/2018, Tuesday

8-30 – 9-30 Breakfast
10-00 – 11-30. Prof. A.S. Vostrikov. Classical and modern methods of the design of feedback loops. Part 1.
11-30 – 13-00. Prof. A.S. Vostrikov. Classical and modern methods of the design of feedback loops. Part 2.
13-30 – 14-30 – Lunch
15-00 – 16-30. Prof. A.A. Voevoda. Multi-channel feedback controlled systems.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

15/08/2018, Wednesday

8-30 – 9-30 Breakfast
10-00 – 11-30. Assistant Prof. A.B. Kolker. The experience of using embedded Linux kernels as a core for industrial intelligent control system. Part 1.
11-30 – 13-00. Assistant Prof. A.B. Kolker. The experience of using embedded Linux kernels as a core for industrial intelligent control system. Part 2.
13-30 – 14-30 – Lunch
15-00 – 16-30. Assistant Prof. A.B. Kolker, Assistant Prof. D.S. Khudyakov.The experience of using embedded Linux kernels as a core for industrial intelligent control system.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

16/08/2018, Thursday

8-30 – 9-30 Breakfast
10-00 – 11-30. Assistant Prof. A.B. Kolker, Assistant Prof. D.S. Khudyakov. Computer vision systems in robotics. Part 1.
11-30 – 13-00. Assistant Prof. A.B. Kolker, Assistant Prof. D.S. Khudyakov. Computer vision systems in robotics. Part 1. Part 2.
13-30 – 14-30 – Lunch
15-00 – 16-30. Prof. V.A. Zhmud (Russia), Prof. L.V. Dimitrov (Bulgaria). Feedback control in real-time robotic systems.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

17/08/2018, Friday

8-30 – 9-30 Breakfast
10-00 – 11-30. Assistant Prof. E.V. Prokhorenko, Assistant Prof. D.S. Khudyakov. Digital signal processing. Part 1.
11-30 – 13-00. Assistant Prof. E.V. Prokhorenko, Assistant Prof. A.B. Kolker. Digital signal processing. Part 1. Part 2.
13-30 – 14-30 – Lunch
15-00 – 16-30. Assistant Prof. A.B. Kolker, Assistant Prof. D.S. Khudyakov. Identification of complex objects and processes.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

18/08/2018, Saturday

8-30 – 9-30 Breakfast
10-00 – 13-30 - Interdisciplinary seminars or Free time (by choice)
13-30 – 14-30 – Lunch
14-30 – 18-00 – Business game on robotics (Team Brainstorm) or Free time (by choice)
18-00 – 19-00 Supper

19/08/2018, Sunday

8-30 – 9-30 Breakfast
10-00 – 13-00 Easy tour
13-00 – 13-30 Free time
13-30 – 14-30 – Lunch
14-30 – 15-30 Discussion brainstorming results, awarding of winners
15-30 – 17-00 Free time
18-00 – 19-00 Supper

20/08/2018, Monday

8-30 – 9-30 Breakfast
10-00 – 11-30. Assistant Prof. A.B. Kolker, Assistant Prof. D.S. Khudyakov. Intellectual sensors and systems. Part 1.
11-30 – 13-00. Assistant Prof. A.B. Kolker, Assistant Prof. D.S. Khudyakov. Intellectual sensors and systems. Part 2.
13-30 – 14-30 – Lunch
15-00 – 16-30. Assistant Prof. E.V. Prokhorenko. Data acquisition systems in robotics.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

21/08/2018, Tuesday

8-30 – 9-30 Breakfast
10-00 – 11-30. Prof. V.A. Zhmud (Russia), Prof. L.V. Dimitrov (Bulgaria). Numerical optimization of feedback-control systems.
11-30 – 13-00. Prof. O.P. Cherkasova. Laser method of the investigation of spices of wildlife. Part 1.
13-30 – 14-30 – Lunch
15-00 – 16-30. Prof. O.P. Cherkasova. Laser method of the investigation of spices of wildlife. Part 2.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

22/08/2018, Wednesday

8-30 – 9-30 Breakfast
10-00 – 11-30. Prof. V.A. Zhmud, Assistant Prof. E.V. Prokhorenko. Methods of laser high-accuracy measuring of distances, shifts and velocity. Part 1.
11-30 – 13-00. Prof. V.A. Zhmud, Assistant Prof. E.V. Prokhorenko. Methods of laser high-

accuracy measuring of distances, shifts and velocity. Part 2.
13-30 – 14-30 – Lunch
15-00 – 16-30. Assistant Prof. A.B. Kolker, Assistant Prof. D.S. Khudyakov. High-speed processing of data flows in real time.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

23/08/2018, Thursday

8-30 – 9-30 Breakfast
10-00 – 11-30. Prof. O.P. Cherkasova. Characteristic responses of biological and nanoscale systems in the terahertz frequency range. Part 1.
11-30 – 13-00. Prof. O.P. Cherkasova. Characteristic responses of biological and nanoscale systems in the terahertz frequency range. Part 2.
13-30 – 14-30 – Lunch
15-00 – 16-30. Prof. V.A. Zhmud. Controlling system for hipper-fine laser spectrometer.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

24/08/2018, Friday

8-30 – 9-30 Breakfast
10-00 – 11-30. Prof. V.A. Zhmud. Basic metrology, optical frequency standard and controlling electronic systems for it.
11-30 – 13-00. Prof. V.A. Zhmud, Assistant Prof. E.V. Prokhorenko. Modern measurement techniques based on super-speed many-digits ADS.
13-30 – 14-30 – Lunch
15-00 – 16-30. Prof. V.A. Zhmud, Prof. G.A. Frantsuzova, Prof. Hubert Roth (Germany), Jaroslav Nosek (Czech Republic), Prof. L.V. Dimitrov (Bulgaria), Prof. Thierry Chateau (France). Prospects of Controlling Systems for Robotics, Mechatronics and Laser Measurers.
16-30 – 17-00. Discussions, answers to the questions.
18-00 – 19-00 Supper

25/08/2018, Saturday

8-30 – 9-30 Breakfast
Departure from Altay to Novosibirsk, accommodation in Novosibirsk (about 10-00), rest and dinner in village Srostki, arrival to Novosibirsk (about 16-00), accommodation, rest, supper and departure to airport.

Formal information

Country – Russia.
University – Novosibirsk State Technical University (NSTU)
Faculty – Automation and Computer Techniques
Summer school title – Controlling Systems for Robotics, Mechatronics and Laser Measurers
Summer school location – Novosibirsk, NSTU and campus in Erlagol, http://www.turistka.ru/altai/info.php?ob=329 Altay, Russia
Duration – From 11/08/2018 to 25/08/2018
Target group – Students (Master degree students)
Summer school`s type – **International**
Language of instruction – **English**
Do you offer national language courses?
We offer
1. Short intensive basic courses of Russian for participant from Germany
2. Short intensive advanced courses of Russian for participant from Germany having basic knowledge of Russian.
3. Short intensive basic courses of Germany for participants from Russia

ECTS points available?
If so, how many? Yes, 2 ECTS- units for students
Participation fee - € 650.00 (per each participant from **Europe**)
Total number of participants – 26
Total number of DAAD scholarships you apply for – 16
Participation of local students – Yes, 8
Application deadline for German students (at least 2 months before a beginning of summer school) – 15/05/2018
Homepage for the summer school Information support – in the Journal "Automatics & Software Enginery" http://jurnal.nips.ru/en And special address in portal of web www.nstu.ru (to be specified later on)
Which application forms should be submitted by the German students? – CV and agreement for the participation in the Summer School, details of passport data (for the official invitation).
Certificates – Personal certificate of participant signed by pro-rector of NSTU
What are the relevant selection criteria? – For the participants from Germany of other European Country: Basic knowledge of English, direction of the education, namely: technical education of bachelor and status of student on master degree
For native student: the same and additionally knowledge of Germany or the certificate-proved knowledge of English. – *How often or when has been your summer school supported by the DAAD*?

First claim on this subject. Plan periodicity for this Summer School is one time per 2 years.
Contact person
Name: Vadim Zhmud, Professor of NSTU, Head of the project? Head of Department of Automation
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Tel. +7-913-473-2997
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22. SHORT DESCRIPTION OF THE CONTENT AND THE PROGRAM OF THE SUMMER SCHOOL, FULL-TIME AND CORRESPONDENCE AUTHOR OF THE REPORT

The participant list of the teaching lecturers includes the following persons

1. Professor Vadim Zhmud, Doctor of Sciences, Head of Department of Automation.
2. Professor Anatoly Vostrikov, Distinguished Lecturer of Russia, Doctor of Sciences.
3. Professor Galina Frantsuzova, Doctor of Sciences, Prof. of the Department of Automation.
4. Professor Alexander Voevoda, Doctor of Sciences, Prof. of the Department of Automation.
5. Professor Olga Cherkasova, Doctor of Sciences, Prof. of the Department of Data Acquisition systems.
6. Assistant Professor Aleksey Kolker, PhD, Dep. Prof. of the Department of Automation.
7. Assistant Professor Eugeniy Prokhorenko, PhD, head of the Department of Data Acquisition systems.
8. Assistant Professor Dmitry Khudyakov, PhD, Dep. Prof. of the Department of Automation.
9. Prof. Lubomir Dimitrov, Honorable doctor of NSTU, Prof. and Vice-Rector of Technical University of Sofia, Sofia, Bulgary.
10. Prof. Hubert Roth, Head of the Department of Automatic Control Engineering of University if Siegen, Professor, Germany.
11. Prof. Jaroslav Nosek Professor of Faculty of Mechatronics, Informatics and Interdisciplinary Education in Czech Technical University, Liberets, Czech Republic.
12. Prof. Thierry Chateau, Head of Department, Professor, Institute Pascal, Université Blaise Pascal, Clermont Ferrand, France.
13. Professor Uranchimeg Tudevdagvin, Professor of Institute of Energy, Doctor of Technical Sciences, Mongolia and Germany (Techniche Universitat Chemnitz)
14. Prof. Wolfram Hardd (Germany) Vice-dean for International Connections, Director of University Computing Center, Professor of Computer Engineering, Chemnitz University of Technology, Germany

Additional bonus for the participants Each participant after the training courses will get Certificate, signed by rector, and the schoolbook with the conspectus of the lectures in English.

It also will contain questions for self-testing of the knowledge.

Destination of the Participation fee 1. Transport charges 2. Habitation.

Information about the Summer School will be published and renewed at web-site http://asc.nstu.ru/ [78].

REFERENCES

[1] Automatic control systems, mechatronics and robotics: monograph / V.A. Zhmud, S.V. Kamensky, G.A. Frantsuzova, Yu. E. Voskoboinikov, E.A. Basynya, V.G. Trubin, A. S. Vostrikov, G.P. Chikildin; under. Ed. G. A. Frantsuzova. - Novosibirsk: Publishing house of the NSTU, 2017. - 210 p. - ISBN 978-5-7782-3136-8. (In Russian).

[2] Zhmud V. A. Designing of the precision automatic control systems: monograph / V. A. Zhmud, L. Dimitrov. - Novosibirsk: KANT, 2017. - 126 p.

[3] V.A. Zhmud, L.V. Dimitrov, O.D. Yadrishnikov. Calculation of regulators for the problem of mechatronics by means of numerical optimization method. 12th International Conference on Actual Problems on Electronic Intrument Engineering APEIE 2014. Proceedings.

[4] Suvorov D.A., Frantsuzova G.A., Zemtsov N.S. Using the Localization Method for Once-through Boiler Control // Proceedings of 9th International Siberian Conference on Control and Communications (SIBCON-2015), Russia, Omsk, May 21−23, 2015. – Omsk: Omsk State Technical University. IEEE Catalog Number: CFP15794-CDR. ISBN: 978-1-4799-7102-2., электронный ресурс (Scopus).

[5] V. A Zhmud, L.V. Dimitrov. Calculation of Desired Coefficients for the Characteristic Equation of Closed Automatic Control System. Recent. Vol. 17 (2016), No. 2 (48), July. 2016. P. 123–132. URL: http://www.recentonline.ro/048/Zhmud-R48m.pdf Румыния. Бухарест. ISSN 1582-0246. Key words: control, regulation, dynamic accuracy, static accuracy, characteristic polynomial of a system, polynomial of desired dynamics

[6] The use of bypass channel for feedback control of oscillatory object well-known as difficult one for control. Vadim Zhmud; Galina Sablina; Lubomir Dimitrov; Vitaly Trubin. 2016 International Siberian Conference on Control and Communications (SIBCON). Year: 2016. Pages: 1 - 6, DOI: 10.1109/SIBCON.2016.7491767. IEEE Conference Publications. http://ieeexplore.ieee.org/document/7491767/

[7] G.V. Sablina, I.V. Stazhilov, V.A. Zhmud. Development of Rotating Pendulum Stabilization Algorithm and Research of System Properties with the Controller. 13th International Scientific-Tachnical Conference on Actual Problems of Electronic Inatruments Engineering (APEIE)–39281. Proceedings. APEIE– 2016. In 12 Volumes. Vol. 1. Part 3. Novosibirsk 2016. IEEE Catalog Number: CFP16471-PRT. ISBN: 978-5-7782-2991-4, 978-5-7782-2992-5 (т.1), ISBN: 978-1-5090-4068-1. P. 165–170. https://cloud.mail.ru/public/FBMT/KugeZk8F7 (Scopus).

[8] Vostrikov A.S. Method of synthesis for electric drive with given transient processes. Thesis for c. ph.-m.sc. Sverdlovsk, 1968. (Ural Politechn. Inst.).

[9] Metod lokalizacii. Stat'ja v Vikipedii. URL: https://ru.wikipedia.org/wiki/Metod_lokalizacii

[10] Vostrikov A.S., Francuzova G.A. Teorija avtomaticheskogo regulirovanija. – M.: Vysshaja shkola. - 2004. - 360 s.

[11] Vostrikov A.S., Frantsuzova G.A., Utkin V.I. Systems with derivatives of state vector in control. Automatics and Telemechanics. 1982. N3. P. 22–25.

[12] Vosrikov A.S. Localization principle in problem of synthesis of automatic control systems. Proborostroenie. 1988. N2. P. 42–49.

[13] Rotach V.Ya. The calculation of industrial automatic control system dynamics. M.: Energia. 1973.

[14] The two methods of reverse overshoot suppression in automation systems / V. A. Zhmud, B. I. Pyakillya, V. M. Semibalamut, M. V. Trubin, O. D. Yadrishnikov // Journal of Telecommunication, Electronic and Computer Engineering. - 2017. - Vol. 9, № 2-2. - P. 153–157.

[15] Zhmud V.A., Pyazkillya B.I., Semibalamut V.M., Trubin M.V., Yadrishnikov O.D. The two methods of reverse overshoot suppression in automation systems. 6 pages. ADVCIT'15. Paper N 1570212705. ISSN 21803722

[16] Zhmud, V., Dimitrov, L. Designing of complete multi-channel PD-regulators by numerical optimization with simulation. 2015. 2015 International Siberian Conference on Control and Communications, SIBCON 2015.

[17] Vostrikov A.S., Voevoda A.A., Zhmud V. A. Control of linear dynamic objects with variable parameters by the method of localization. Preprint No 462, Inst. of Automation and Electrometry, Sib. branch USSR Ac. Sci., Novosibirsk, 1990. – 56 p.

[18] Detection of unrevealed non-linearities in the layout of the balancing robot. Andrey Ivoilov; Vadim Zhmud; Vitaly Trubin; Lubomir Dimitrov. 2016 International Siberian Conference on Control and Communications (SIBCON). Year: 2016. Pages: 1 - 9, DOI: 10.1109/SIBCON.2016.7491853. IEEE Conference Publications. Detection of unrevealed non-linearities in the layout of the balancing robot. Published in: Control and Communications (SIBCON), 2016 International Siberian Conference on, Date of Conference: 12-14 May 2016, http://ieeexplore.ieee.org/document/7491853/

[19] V.A. Zhmud, S.V. Bugrov, R.A. Lisovoy, A.B. Kolker. The perspective view of the adaptive stabilization on the base of the regulator gain deviation. // Proceedings of DST-RFBR-Sponsored Indo-Russian Joint Workshop on Computational Intelligence and Modern Heuristics in Automation and Robotics. S. V. National Institute of Technology, Surat – 395 007, Gujarat, India. 20th - 22nd September 2010. pp. 46–48.

[20] Zhmud V. A. Identification and Control of Object with Time-Delay Link / V.A, Zhmud, B. I. Pyakillya // Journal of Telecommunication, Electronic and Computer Engineering. - 2017. - Vol. 9 - No. 2-2. - P. 109–113. - ISBN 2180-1843.

[21] Zhmud V.A., Pyazkillya B.I. Identification and Control of Object with Time-Delay Link. 6 pages. ADVCIT'15. Paper N 1570207827. ISSN 21803722

[22] Zhmud V. A. The use of sigma-delta-ADC in the commutation mode / V. A. Zhmud, L. V. Dimitrov, A. V. Taichenachev // International Siberian conference on control and communications (SIBCON): proc., Kazakhstan, Astana 29–30 June 2017. – Astana: S. Seifullin Kazakh Agrotechn. Univ., 2017. – P. 640-643. - ISBN 978-1-5090-1082-0. - DOI: 10.1109/SIBCON.2017.7998562.

[23] Zhmud V.A., Yadryshnikov O.D., Zavorin A.N., Prokhorenko E.V., Rao R.V. The Improvement of the Qualitative Characteristics Of Control Systems With Feedback At Use PI2D2-Regulator // Proceedings of the Fifth International Conference on Advances in Mechanical Engineering (ICAME-2011), June 06-08, 2011. Surat – 395 007, Gujarat, India. pp. 280-287.

[24] Zhmud V.A., Polishchuk A.N., Voevoda A.A., Rao R. V. The Tuning of the PID-Regulator for Automatic Control System of Thermo Energetic Equipment // Proceedings of the Fifth International Conference on Advances in Mechanical Engineering (ICAME-2011), June 06-08, 2011. Surat – 395 007, Gujarat, India. pp. 254-263.

[25] Zhmud, V., Dimitrov, L. Adaptive systems based on competitive quality criteria, 2015. 2015 International Siberian Conference on Control and Communications, SIBCON 2015.

[26] Zhmud, V., Zavorin, A. The design of the control system for object with delay and interval-given parameters, 2015. 2015 International Siberian Conference on Control and Communications, SIBCON 2015.

[27] Zhmud V.A., Yadrishnikov O.D., Semibalamut V.M. Control of the objects with a single output and with two or more input channels of influence. WIT Transaction on Modelling and Simulation. Vol.59, 2015. WIT Press. www.witpress.com, ISSN 1743-355X. P. 147 – 156.

[28] Zhmud V.A., Zavorin A.N. Metodi di ottimizzazione del controllo numerico su una modelli troncati. Italian Science Review. 2014; 4(13). PP. 686-689. Available at URL: http://www.ias-journal.org/archive/2014/april/Zhmud.pdf.

[29] Zhmud V.A., Imekov D. B., Lastochkin K.Yu., Lukicheva A.V. New Structure of Regulator for Controlling of Object with Oscillation Features and its Modelling Testing. Proceedings of International Conference on Engineering and Applied Sciences Optimization (OPT-i-2014). Kos Island, Greece, 4-6 June 2014.

[30] Zhmud V.A. New Modeling Tested Method for Controlling of Object with Oscillation Features. Proceeding of 2014 International Conference on Mechanical Design, Manufacture and Automation Engineering (MDMAE 2014). ISBN: 978-1-60595-156-0. Thailand, Phuket. Part II. Author statement: Novosibirsk State Technical University, Novosibirsk, Russia. P.289 – 296.

[31] Zhmud V. A.. The Use of the Feedback Control Systems in Laser Physics Researching Experiments. // Proceedings of RFBR and DST Sponsored “The 2-nd Russian-Indian Joint Workshop on Computational Intelligence and Modern Heuristics in Automation and Robotics”, 10 – 13 September, 2011, Additional volume, pp.40–43.

[32] Zhmud V.A., Voevoda A.A., Semibalamut V.M., Tereshkin D.O. Adaptive control of object with delay // Proceedings of DST-RFBR-Sponsored Second Indo-Russian Joint Workshop on Computational Intelligence and Modern Heuristics in Automation and Robotics. NSTU, Novosibirsk, Russia. 9th – 12th September 2011. Новосибирск, НГТУ. pp. 94–96.

[33] Zhmud V.A., Voevoda A.A., Semibalamut V.M., Tereshkin D.O. New structures of adaptive feedback systems. // Proceedings of DST-RFBR-Sponsored Second Indo-Russian Joint Workshop on Computational Intelligence and Modern Heuristics in Automation and Robotics. NSTU, Novosibirsk, Russia. 9th – 12th September 2011. Новосибирск, НГТУ. pp. 89–93.

[34] Zhmud V. A. Numerical optimization of PID-regulator for object with distributed parameters / V. A. Zhmud, B. I. Pyakillya, A. V. Liapidevskii //

Journal of Telecommunication, Electronic and Computer Engineering. - 2017. - Vol. 9, № 2-3. - P. 9–114.

[35] Zhmud V. A. The influence of the type of the test signal on the result of numerical optimization of regulators / V. A. Zhmud, L. V. Dimitrov // Journal of Physics: Conference Series. - 2017. - Vol. 803. - Art. 012186 (6 p.). - DOI: 10.1088/1742-6596/803/1/012186. - Работа выполнена: при поддержке Министерства образования и науки.

[36] Calculation of PID-regulator for MISO system with the method of numerical optimization / V. A. Zhmud, L. V. Dimitrov, A. V. Taichenachev, V. M. Semibalamut // International Siberian conference on control and communications (SIBCON): proc., Kazakhstan, Astana 29–30 June 2017. – Astana: S. Seifullin Kazakh Agrotechn. Univ., 2017. – P. 670-676. - ISBN 978-1-5090-1082-0. - DOI: 10.1109/SIBCON.2017.7998568.

[37] Zhmud V. A. Design of robust systems by means of the numerical optimization with harmonic changing of the model parameters / V. A. Zhmud, I. L. Reva, L. V. Dimitrov // Journal of Physics: Conference Series. - 2017. - Vol. 803. - Art. 012185 (6 p.). - (International conference on information technologies in business and industry, Tomsk, 21–26 Sept. 2016). - DOI: 10.1088/1742-6596/803/1/012185.

[38] Zhmud V. A. Model study of automatic and automated control of hysteretic object / V. A. Zhmud, L. V. Dimitrov, A. B. Taichenachev // International Siberian conference on control and communications (SIBCON): proc., Kazakhstan, Astana 29–30 June 2017. – Astana: S. Seifullin Kazakh Agrotechn. Univ., 2017. – P. 655-659. - ISBN 978-1-5090-1082-0 . - DOI: 10.1109/SIBCON.2017.7998565. - Работа выполнена: при поддержке Министерства образования и науки.

[39] Zhmud V.A., Pyazkillya B.I., Liapidevskiy A.V. Numerical optimization of PID-regulator for object with distributed parameters. 6 pages. ADVCIT'15. Paper N 1570214556. ISSN 21803722

[40] Zhmud V.A., Voevoda A.A., Ishimtsev R.Yu., Semibalamut V.M.. New structures and methods of the scalar and multichannel regulators for non-linear and/or delayed objects. // Proceedings of DST-RFBR-Sponsored Indo-Russian Joint Workshop on Computational Intelligence and Modern Heuristics in Automation and Robotics. S. V. National Institute of Technology, Surat – 395 007, Gujarat, India. 20th - 22nd September 2010. pp. 63–67.

[41] Zhmud V.A., Zavorin A.N. Fractional order PID-regulators and method of their simplification with the increase of the controlling effect. Proceedings of the 8-th International Forum on Strategic Technology 2013 (IFOST-2013), vol. II, 28 June – 1 July. Mongolian University of Science and Technology, Ulaanbaator, Mongolia. IEEE organized. 2013. P. 250 – 255. http://www.must.edu.mn/IFOST2013/

[42] Zhmud V.A., Yadrishnikov O.D. Numerical optimization of PID-regulators using the improper moving detector in cost function. Proceedings of the 8-th International Forum on Strategic Technology 2013 (IFOST-2013), vol. II, 28 June – 1 July. Mongolian University of Science and Technology, Ulaanbaator, Mongolia. IEEE organized. 2013. P. 265 – 270. http://www.must.edu.mn/IFOST2013/

[43] Zhmud, V.A., Liapidevskiy, A.V., Prokhorenko, E.V. The design of the feedback systems by means of the modeling and optimization in the program vissim 5.0/6. 2010. Proceedings of the IASTED International Conference on Modelling, Identification and Control. PP. 27–32.

[44] Zhmud V.A., Yadrishnikov O.D., Poloshchuk A.N., Zavorin A.N. Modern key techologies in automatics: Structures and numerical optimization of regulators. 2012. Proceedings - 2012 7th International Forum on Strategic Technology, IFOST 2012.

[45] Zhmud V.A., Semibalamut V.M., Voevoda A.A., Ishimtsev R.Yu. The use of by-pass High-Frequency channel in feedback control systems. // Proceedings of the 17th IASTED International Conference "Applied Simulation and Modeling" (ASM 2008). June 23-25, 2008. Corfu, Greece. P.234 – 238.

[46] Voevoda A.A., Ishimtsev R.Yu., Zhmud V.A. The convergence of the algorithms for the optimization of regulator for an object with restriction and delay. // Proceedings of the 17th IASTED International Conference "Applied Simulation and Modeling" (ASM 2008). June 23-25, 2008. Corfu, Greece. P.182 – 186.

[47] Zhmud V.A., Semibalamut V. M., Ishimtsev R.Yu. Metrological feedback control: the suppression of non-direct influence when multiply connected system being precisely stabilized with multivariate feedback loop // Proceedings of the V International Symposium 'Modern Problem of Laser Physics'- MPLP'2008. Edited by S.N. Bagayev and P.V. Pokasov. – Novosibirsk. 2009. P.346–359.

[48] Voevoda A.A., Zhmud V.A., Ishimtsev R.Yu., Semibalamut V.M. The modeling tests of the new PID-regulators structures. // Proceedings of the 18th IASTED International Conference "Applied Simulation and Modeling" (ASM 2009). Sept. 7-9, 2009. Palma de Mallorka, Spain. P.165 – 168.

[49] Voevoda A.A., Farnosov A.S., Zhmud V.A. High-speed phase-locked-loop frequency control of identical lasers. Proceedings of SPIE, Novosibirsk, 2002, vol.4900. p. 346-351.

[50] V.A. Zhmud, V.M. Semibalamut, L.V. Dimitrov, Yu.N. Fomin. Optoelectronic intellectual systems for monitoring of Earth seismic dynamics: results and developing directions. 16th International Multidisciplinary Scientific GeoConference CGEM 2016. Conference proceedings. Book 1. Dcience and Technologies in Geology, Ecploration and Mining. Volume III. P. 567–574. ISSN 1314-2704. DOI: 10.5593/sgem2016B13. URL: www.sgem.org.

[51] V.A. Zhmud, V.M. Semibalamut, L.V. Dimitrov, D.O. Tereshkin. Software structure for the laser sensor of the Earth crust Lunar-Solar tide deformations. 16th International Multidisciplinary Scientific GeoConference CGEM 2016. Conference proceedings. Book 1. Dcience and Technologies in Geology, Ecploration and Mining. Volume III. P. 615–622. ISSN 1314-2704. DOI: 10.5593/sgem2016B13. URL: www.sgem.org.

[52] Modification of optoelectronic intellectual systems for absolute measurements in monitoring of Earth seismic dynamics / V. A. Zhmud, V. M. Semibalamut, V. M. Dimitrov, A. V. Taichenachev // 17 International multidisciplinary scientific geoconference, SGEM 2017 : conf. proc., Bulgaria, Albena, 29 June – 5 July 2017. – Sofia : STEF92 Technology Ltd., 2017. – Vol. 17, iss. 21. – P. 999–1004. - 300 copy - ISBN 978-619-7408-01-0. - DOI: 10.5593/sgem2017/21.

[53] The increase of the accuracy of laser-based measurements of ultra-low tidal deformations of

rocks / V. A. Zhmud, V. M. Semibalamut, L. V. Dimitrov, Y. N. Fomin // 17 International multidisciplinary scientific geoconference, SGEM 2017 : conf. proc., Bulgaria, Albena, 29 June – 5 July 2017. – Sofia: STEF92 Technology Ltd., 2017. – Vol. 17, iss. 21. – P. 1069–1076. - ISBN 978-619-7408-01-0. - DOI: 10.5593/sgem2017/21V.I.

[54] Gololobov, A.V. Liapidevskiy, A.S. Drozdov, A.Z. Zakharov, V.P. Filippov, V.A. Zhmud. Prospects of the Development of Firmware Complex AKTOMIKA. XIII Международная научно-техническая конференция АПЭП 2016. 13th International Scientific-Tachnical Conference on Actual Problems of Electronic Inatruments Engineering (APEIE)–39281. Proceedings. APEIE– 2016. In 12 Volumes. Vol. 1. Part 1. Novosibirsk 2016. IEEE Catalog Number: CFP16471-PRT. ISBN: 978-5-7782-2991-4, 978-5-7782-2992-5 (т.1), ISBN: 978-1-5090-4068-1. P. 302–308. https://cloud.mail.ru/public/FBMT/KugeZk8F7 (Scopus).

[55] V.A. Zhmud, A.M. Goncharenko. Modern Ways of High-Precision Frequency Measurements. 13th International Scientific-Tachnical Conference on Actual Problems of Electronic Inatruments Engineering (APEIE)–39281. Proceedings. APEIE– 2016. In 12 Volumes. Vol. 1. Part 1. Novosibirsk 2016. IEEE Catalog Number: CFP16471-PRT. ISBN: 978-5-7782-2991-4, 978-5-7782-2992-5 (т.1), ISBN: 978-1-5090-4068-1. P. 309–313. https://cloud.mail.ru/public/FBMT/KugeZk8F7 (Scopus).

[56] V.A. Zhmud, A.M. Goncharenko. Modern Problems of High-Precision Measurements of the Phase Differences. 13th International Scientific-Tachnical Conference on Actual Problems of Electronic Inatruments Engineering (APEIE)–39281. Proceedings. APEIE– 2016. In 12 Volumes. Vol. 1. Part 1. Novosibirsk 2016. IEEE Catalog Number: CFP16471-PRT. ISBN: 978-5-7782-2991-4, 978-5-7782-2992-5 (т.1), ISBN: 978-1-5090-4068-1. P. 314–318. https://cloud.mail.ru/public/FBMT/KugeZk8F7 (Scopus).

[57] V. A Zhmud, L.V. Dimitrov, A.V. Liapidevsky. A new Method and Device for High-Speed, Accurate and Reliable Phase Difference Measurement. Recent. Vol. 18 (20176), No. 2 (52), July. 2017. P. 127–131. URL: http://www.recentonline.ro/052/Zhmud-R52.pdf Румыния. Бухарест. ISSN 1582-0246.

[58] Ullmann F. Machine learning algorithms for impact localization on formed piezo metal composites / F. Ullmann, W. Hardt, V. A. Zhmud // International Siberian conference on control and communications (SIBCON): proc., Kazakhstan, Astana 29–30 June 2017. – Astana: S. Seifullin Kazakh Agrotechn. Univ., 2017. – P. 589-593. - ISBN 978-1-5090-1082-0. - DOI: 10.1109/SIBCON.2017.7998552. - Работа выполнена: при поддержке DFG (Deutsche Forschungsgemeinschaft) within the Federal Cluster of Excellence EXC 1075 ”MERGE”.

[59] O.P. Cherkasova, M.M. Nazarov, A.P. Shkurinov, Terahertz spectroscopy for diabetes diagnostics // EPJ Web of Conferences 149, 05013 (2017).

[60] Milekhin, A.G., Cherkasova, O., Kuznetsov, S.A., et al, Nanoantenna-assisted plasmonic enhancement of IR absorption of vibrational modes of organic molecules // Beilstein Journal of Nanotechnology, 8 (1), p. 975-981, 2017, doi:10.3762/bjnano.8.99 (SCOPUS; IF 3.13).

[61] O.A. Smolyanskaya, O.V. Kravtsenyuk, A.V. Panchenko, E.L. Odlyanitskiy, J.P. Guillet, O.P. Cherkasova, M.K. Khodzitsky, Study of blood plasma optical properties in mice grafted with Ehrlich carcinoma in the frequency range 0.1 –1.0 THz // Quantum Electronics 47 (11) 1031 – 1040 (2017).

[62] O.P. Cherkasova, M.M. Nazarov, A.P. Shkurinov, Properties of aqueous solutions in THz frequency range // Journal of Physics Conference Series, 2017, 793(1):012005, DOI 10.1088/1742-6596/793/1/012005

[63] O.P. Cherkasova, M. M. Nazarov, A. A. Angeluts, A. P. Shkurinov. Analysis of blood plasma at terahertz frequencies // Optics and Spectroscopy, 120(1):50-57, January 2016

[64] O.P. Cherkasova, M. M. Nazarov, A. P. Shkurinov. Noninvasive blood glucose monitoring in the terahertz frequency range // Optical and Quantum Electronics, 48(3), March 2016

[65] M.M. Nazarov, O.P. Cherkasova, A.P. Shkurinov. Study of the dielectric function of aqueous solutions of glucose and albumin using pulsed THz spectroscopy // Quantum Electronics, 46 (6), 488-495, 2016

[66] O.P. Cherkasova, M.M. Nazarov, A.P. Shkurinov et al, Studying human and animal skin optical properties by terahertz time-domain spectroscopy // Bulletin of the Russian Academy of Sciences Physics 80(4):479-483, 2016

[67] O. P. Cherkasova, M.M. Nazarov, A.P. Shkurinov. Investigation of bovine serum albumin glycation by THz spectroscopy // Proc. SPIE 9917, Saratov Fall Meeting 2015: Third International Symposium on Optics and Biophotonics and Seventh Finnish-Russian Photonics and Laser Symposium (PALS), 991706 (April 21, 2016); doi:10.1117/12.2229741; http://dx.doi.org/10.1117/12.2229741

[68] N.V. Chernomyrdin, K.I. Zaytsev, A.D. Lesnichaya, K.G. Kudrin, O.P. Cherkasova, V.N. Kurlov, I.A. Shikunova, A.V. Perchik, S.O. Yurchenko, I. V. Reshetov. Principle component analysis and linear discriminant analysis of multi-spectral autofluorescence imaging data for differentiating basal cell carcinoma and healthy skin // Imaging Spectrometry XXI, edited by John F. Silny, Emmett J. Ientilucci, Proc. of SPIE Vol. 9976, 99760B, 2016, doi: 10.1117/12.2237607

[69] Cherkasova O.P., Nazarov M.M., Shkurinov A.P. Noninvasive blood glucose monitoring with THz reflection spectroscopy // Photonics & Lasers in Medicine, 2016; 5(4): 301-303

[70] O.P. Cherkasova, M.M. Nazarov, A.P. Shkurinov. Dielectric Properties of Albumin and Glucose Solutions in the THz Frequency Range // IEEE, doi:10.1109/IRMMW-THz.2016

[71] E. Shirshin, O. Cherkasova, T. Tikhonova, E. Berlovskaya, A. Priezzhev, V. Fadeev. Native fluorescence spectroscopy of blood plasma of rats with experimental diabetes: Identifying fingerprints of glucose-related metabolic pathways // Journal of Biomedical Optics. V. 20(5). P. 51033 (2015). DOI:10.1117/1.JBO.20.5.051033 ·

[72] O. P. Cherkasova, M. M.Nazarov, A. P. Shkurinov. The Investigation of Blood and Skin THz Response at High Glucose Concentration // The 40th International Conference on Infrared, Millimeter and

Terahertz Waves (IRMMW-THz 2015), 23-28 August 2015, Hong Kong, IEEE, doi:10.1109/IRMMW-THz.2015.7327417
[73] A.A. Angeluts, A.V. Balakin, M.G. Evdokimov, M.N. Esaulkov, M.M. Nazarov, I.A. Ozheredov, D.A. Sapozhnikov, P.M. Solyankin, O.P. Cherkasova, A.P. Shkurinov, Characteristic responses of biological and nanoscale systems in the terahertz frequency range // Quantum Electronics 44 (7) 614 – 632 (2014)
[74] O. P. Cherkasova, M. M. Nazarov, I. N. Smirnova, A. A. Angeluts, and A. P. Shkurinov. Application of Time-Domain THz Spectroscopy for Studying Blood Plasma of Rats with Experimental Diabetes // Physics of Wave Phenomena, 2014, Vol. 22, No. 3, pp. 185-188.
[75] O. P. Cherkasova, B. F. Minaev, G. V. Baryshnikov, L. I. Tkachenko, V. A. Minaeva, I. N. Smirnova, D. A. Sapozhnikov, A.V. Kargovsky, A. P. Shkurinov. Analysis of intermolecular interactions in progesterone and 17α-hydroxyprogesterone crystals // The 38th International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz 2013), Mainz on the Rhine, September 1 – 6, 2013, We P2-08.
[76] I.N. Smirnova, D.A. Sapozhnikov, A.V. Kargovsky, V.A. Volodin, O.P. Cherkasova, R. Bocquet, A.P. Shkurinov. Lowest-lying vibrational signatures in corticosteroids studied by terahertz time-domain and Raman spectroscopies // Vibrational Spectroscopy. 2012. Vol. 62 .P. 238– 247.
[77] O.P. Cherkasova, A.V. Kargovsky, M. M. Nazarov, I.N.Smirnova, A.P. Shkurinov The effect of the nature of hydrogen bonding on THz and Raman spectra of cyclopentaphenanthrene derivative s// 36th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz 2011), 2-7 October, 2011, Houston TX USA: proceedings. Th4-D4.
[78] Summer School "Controlling Systems for Robotics, Mechatronics and Laser Measurers" http://asc.nstu.ru

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