

## ABSTRACTS

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UDC 681.5

### OPTIMIZATION OF DISCRETE PID-ALGORITHMS STRUCTURE

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**Research Methodology.** The research is based on the methods of theory of continuous and digital regulation systems, theories of feedback systems and parametric optimization of automatic systems. For proving the fidelity of theoretic research imitation, modelling methods have been used.

**Results.** The comparative quantitative analysis of the quality of regulation automation systems functioning on the basis of different structure discrete PID-algorithms, carried out in the course of research, showed that the quality of transitory processes by their integral square assessment in systems with discrete regulators compared with continuous system gets slightly worse. At the same time, the best approximation is achieved at the optimal structure of digital controller. The use of discrete optimal structure PID-regulator allows to improve significantly the quality of the system compared to the serial discrete PID-regulator.

**Novelty.** With the aim of solving the problem of the rational choice of the structure of discrete algorithms choosing discretization methods from the condition of maximum approximation of complex frequency characteristics (CFC) of the discrete analogue to CFC of continuous prototype has been suggested. It has been shown that the optimal in this case discrete PID-algorithm can be provided with integral component discretization by backward Euler, and derivative component discretization by trapezoidal method.

**Practical Significance.** The suggested method can be widely used in automatization practice for creating high quality regulation systems with discrete PID-algorithms, as the program realization of discrete regulator optimal structure does not involve any difficulties and does not demand any additional economic expenses.

**UDC 681.515****DENORMALIZATION OF MANAGEMENT  
IN SYSTEMS WITH FUZZY REGULATOR**

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**Research Methodology.** The methodological basis of the research consists of fuzzy models and systems. To solve the problem, the theory of automatic control has been used to construct the model of the system of automatic control, fuzzy models for the construction of a fuzzy P-regulator, the Simulink package for constructing a structural scheme of the simulation model of the fuzzy automatic control system, conducting the simulation, construction of schedules of transient processes, control and definition of the quality of regulation and performance of the system.

**Results.** In the study, the scheme of the denormalization block necessary for ensuring the creation of a physical regulatory effect on the object in fuzzy systems that work with normalized functions and normalized signals has been worked out. The simulation model of the system with fuzzy P-regulator has been worked out and the results of the simulation modeling, which have proved the working capacity and the efficiency of the worked out block of denormalization management and high quality of regulation have been presented.

**Novelty.** Scientific novelty of the obtained results is that the elaborated scheme and the determined parameters of the block of denormalization provide the work of the fuzzy system for different modes of operation of automatic control systems.

**Practical Significance.** The scheme of the denormalization block and the simulation model of the fuzzy system in Matlab package have been worked out: Simulink allows determining the optimal parameters for setting up a fuzzy P-regulator interactively, which is convenient for practical applications.

**UDC 659.023****SYNTHESIS OF TWO-PARAMETER AUTOTYPICAL TONE  
REPRODUCTION OF SHORT INK-PRINTING SYSTEMS OF THE  
SEQUENTIAL STRUCTURE**

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**Research Methodology.** The methodological basis of the study is a spatial two-parameter auto-type tone reproduction. To solve this problem, the theory of screening

for modulation and negation of ink flows using a bitmap printing plate in the printing system, the theory of graphs for describing the modulated flows, the theory of errors for determining the deviation of the characteristics of tone reproduction from linearity, and the simulation modeling for constructing a simulation model of two-parameter auto-type tone reproduction of short printing systems, the correction of processes of screening and printing and the construction of characteristics of auto-type tone reproduction.

**Results.** In the conducted research, the model of two-parameter auto-type reproduction of images and the method of correctional synthesis have been worked out as well as compensating for the nonlinearity of the processes of screening and printing in a short printing system with a raster element of a square shape. The structural scheme of the simulation model of two-parameter auto-type tone reproduction for a short printing system has been developed, which simultaneously calculates the tone reproduction characteristics for the original and corrected system and their deviation from nonlinearity.

**Novelty.** The scientific novelty of the obtained results is that the elaborated model of two-parameter auto-typical tone reproduction provides an adequate description of tone reproduction and extends its application at the stage of preparing images for printing.

**Practical Significance.** The simulation model of autotype tone reproduction in the Matlab Simulink allows determining the parameters of the correction level interactively, which provides the requirements for linearity reproduction in the corrected printing systems.

**UDC 655.027**

### **MODEL OF AUTOTICAL TONE REPRODUCTION OF RASTER IMAGES IN THE FLEXOGRAPHIC PRINTING SYSTEM OF THE SEQUENTIAL STRUCTURE**

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**Research Methodology:** The methodological basis of the study is the auto-type tone transfer of images. To solve this problem, the theory of screening for the modulation of ink flows by a raster printing form in the flexographic printing system, we have used the theory of graphs for describing the structure and dye flows, and the simulation modeling for constructing an imitation model for bitmap images and printing, and the calculation and visualization of the characteristics of auto-type tone transfer and their deviation from linearity.

**Results.** In the conducted research, the model of autotypic tonal transfer of raster images in a flexographic printing system of a successive structure, expressed in terms of the amount of paint per unit area, has been worked out. The structural scheme of the simulation model in the Matlab package, Simulink, which simultaneously calculates and visualizes the characteristics of the tone bandwidth of its deviation from the linearity, has been developed. The results of the imitation modeling in the form of tone reproduction characteristics when reproducing a linear raster scale have been developed. It has been established that the maximum deviation from the linearity is on the average range and is + 13.2%, which does not meet the normative requirements for quality book products.

**Novelty.** The scientific novelty of the obtained results is that the model of autotype tone transfer has been worked out, which provides an adequate description of tone and application to the preparation of images for castration.

**Practical Significance.** A simulation model of autotype tone transfers in the Matlab package has been worked out: Simulink allows you to calculate and construct the characteristics and analyze the properties of the flexographic printing system.

**UDC 681.61:621.795.3+676.264**

### **MODERNIZATION OF INFORMATION-CONTROLLING DEVICE OF THE LACQUERING MACHINE BASED ON PROGRAMMABLE LOGIC CONTROLLER**

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**Research Methodology.** The experimental method in the development and researching of the physical model of information controlled device (ICD), the application of the method of simulation of its work on a computer in the FBD (Functional Block Diagram) editor using the LOGO! Soft Comfort program and mathematical modeling.

**Results.** A laboratory sample of ICD lacquering machine has been developed based on the using of programmable logic controllers, which are produced serially and correspond to the achievement of needed level of scientific and technical developments.

**Novelty.** The general issues of designing the ICD of a lacquering machine on the basis of programmable logic controllers, which makes measurements and adjusting the temperature of drying lacquer prints, ensures the formation of packets of sheets of a certain amount, which records the total number of lacquered prints and measures the productivity (speed) of LM operations in units of cycle/min.

**Practical Significance.** The use of ICD for its lacquering machine increase productivity performance is reduced by the additional time which required to count and form packets of a certain amount of lacquered prints by a single worker. It increases the accuracy of the calculated, the quality of lacquering and the culture of production. The results of the work can be implemented in printing enterprises when modernizing lacquering machines and in the educational process within of the development of scientific and technical support of the regional cluster «Publishing and Printing».

**UDC 629.3.083**

### **AUTOMATION OF ELECTRONIC IGNITION SYSTEMS DIAGNOSTICS OF AUTOMOTIVE GAS ENGINES**

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**Research Methodology.** Different methods of a diagnostics electronic ignition systems of a modern cars have been analyzed. In developing an algorithm for diagnostics of the ignition systems, priority is determined by the method of correlation analysis of the spectral density of the power of the signals of the primary circle. Incoming and outgoing control during diagnostics and repair operations are accompanied by control of the environmental characteristics of the automotive engine to avoid hidden defects. Due to the replenishment of databases of spectral density of signals of the primary circle and the diagnosed cars, the diagnostic system of electronic ignition systems of the car is adaptive.

**Results.** The adaptive system of diagnosing electronic ignition systems of cars has been suggested, and the algorithm of functioning of the central processor of such a system has been developed, which ensures high reliability of the installation of the ignition system problems and reduces the time spent on the diagnostic process in 2-3 times in comparison with the traditional methods.

**Novelty.** Scientific novelty consists in the establishment of a certain sequence of diagnostic procedures and repair operations to obtain a reliable diagnosis of the ignition system of the car at a minimal cost of time.

**Practical Significance.** The suggested methodology may be used at service stations for the diagnosis and repair of electronic ignition systems of cars.

UDC 681.624

**MATHEMATICAL MODEL DETERMINATION OF INK TRANSFER  
ON MATERIAL THAT IS PRINTED BY THE EXPERIMENTAL DATA  
RESULTS**

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**Research Methodology.** To find the mathematical model of ink transfer on the printed material, the general scientific methods have been used: analysis, comparison and generalization. During the fulfillment of the scientific work in determining the model of ink transfer on paper we have used methods of research and data analysis, the method of the Chebysian approximation by functions, linear programming, correlation-regression analysis. The regression analysis of experimental data was performed using the CurveExpert specialized program.

**Results.** The analysis of the existing mathematical description of ink transfer on the printed material has been carried out. The nonlinear dependence of the ink transfer coefficient on a paper from its thickness on a form has been established. An algorithm for the Chebyshev approximation has been described. As a result of experimental data approximation a mathematical dependence of the ink transfer coefficient from a form on a paper on its thickness on the form has been obtained. It has been determined that it has the character of the fractional-rational function of the second degree.

**Novelty.** The method of determining the dependence of the ink transfer coefficient on a printed material from its thickness on a form or an offset cylinder has been developed. The suggested approach can be used to obtain dependencies of the ink transfer coefficients for different grades of paper.

**Practical Significance.** The obtained mathematical model of the dependence of the ink transfer coefficient on the printed material from its thickness on the form or offset cylinder adequately reflects the process of ink transfer and it is convenient for the construction of simulators of ink printing systems.

**UDC 512.643****LOCALIZATION OF CHARACTERISTIC ROOTS OF REGULAR  
MATRIX POLYNOMIALS**

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**Research Methodology.** A general scientific method has been used, which is based on studying and researching the properties of values of a numerical matrix, their placement in certain areas of the complex plane.

**Results.** The localization of characteristic roots of regular matrix polynomials on the elements of matrix – coefficients of these polynomials has been studied. In case when the matrix polynomial decomposes into a product of linear factors, the localization of characteristic roots is considered according to the matrices that are included in this decomposition.

**Novelty.** The properties of Gershgorin circles of a numerical matrix have been applied to study the localization of the characteristic roots of a polynomial matrix written in the form of a matrix polynomial.

**Practical Significance.** The results of the research can be used in the applied problems of linear algebra, in particular the theory of matrix polynomials and the theory of stability.

**UDC 004.946+378.147.88+655.15.011.56****TECHNIQUES OF DESIGNING OF CLIENT-SERVER PLATFORM  
FOR LEARNING EXPERIMENT WITH INTEGRATION OF THE  
MANUFACTURING TELEMETRY**

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**Research Methodology.** The methodological basis of the study are the principles of the theory of design and applied programming, focusing on determining the means of developing an object-oriented educational environment. For review of recent researches and publications, common scientific methods - comparison, synthesis, analysis, synthesis, which made it possible to distinguish the most significant achievements in the direction of using information and communication technologies

in the educational process, have been used. Thus, the theory of mathematical modeling and separate sections of the theory of graphs are used to create an information model of the virtual environment of experimental research and to construct a refined notation of the technological format of workflows.

**Results.** In the conducted research the directions of further informatization of the academic process by means of qualitative expansion of the functional of computerized educational systems have been given. The set of interconnected methods of designing of infocommunication technology of experimental researches using *Matlab* computational resources has been presented. The network mechanisms for integrating the accumulated information of the production process into the academic basis of methodical materials have been determined and expanded.

**Novelty.** The scientific novelty of the results obtained is to develop an original methodology for designing a client-server platform for a learning experiment with an operational addition the results of production telemetry to adapt the content of the training exercises and components of the subject domain to the standards and requirements of the profile industry, which will increase the efficiency of virtual computer environments for the implementation of laboratory works.

**Practical Significance.** The integration of information flows of a printing corporation with a projected environment for experimental research of institution of higher education will improve the quality of professional training of engineering and technical workers, teaching them on examples of real production. Also, with the development of the JDF format and expanding the functionality of the information portal of the operational printing centers, the information-communicating virtual platform presented can serve for the deployment of interactive supervisor systems of the technological process.

UDC 004.415+004.5

## DESIGN OF THE GRID GENERATOR STRUCTURE FOR PREPARATION OF THE WEB INTERFACES

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**Research Methodology.** Application programming methods are used to design the kernel of the developed framework. For reviewing researches and publications we have used the methods of comparison, generalization, and analysis, which made it possible to detect differences in the structure of existing means of generating interfaces.

**Results.** The study provides an opportunity for the qualitative design of multi-user interfaces by using a set of components of a modular structure included in one



core. The possibilities of integrating the combination of the designed framework with the collection system of GULP projects and the feasibility of using local variables that can override the global environment parameters have been determined and expanded.

**Novelty.** The scientific novelty of the results obtained is the development of a means of automated generation of cascading style sheets with automatic change of parameters in the block of local variables when designing a multi-user web interface, which will increase the effectiveness of developing web interfaces, both using the systems of project assembly and without them.

**Practical Significance.** Creating a modular structure of a projected framework will improve the flexibility of using a software product by isolating namespaces for non-intersecting modules. Also, with the integration of external compilation systems such as GULP projects the presented framework can serve for the rapid preparation of the user interface.

**UDC 621.373.54;374.4**

#### **ANALYSIS AND PERSPECTIVES FOR THE DEVELOPMENT OF DIGITAL SYNTHESIZERS OF DIRECT SYNTHESIS OF FREQUENCY**

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**Research Methodology.** The methodological basis of the research is an analysis of the number of perspective digital frequency synthesizers development, their characteristics and manufacturing technologies. General scientific methods – comparison, generalization, analysis, which gave the opportunity to distinguish the most essential in the principles of constructing established frequency synthesizers – have been used to reveal the state of this theme development.

**Results.** Technologies of high-frequency DFS production have been analyzed in this research and high-frequency semiconductors technologies have been suggested to use, in particular, based on InP, SiGe and GaAs. It has been shown that in the development of perspective DHS considerable attention should be paid not to the expansion of the frequency range, but to the deeper processing of the scheme as a whole. The main task is to provide quality indicators for digital frequency synthesizers. It is necessary to use actively various methods of increasing the efficiency already used in structures of existing DFSs, for example, randomization of parasitic components in DFS, principles of high-performance phase accumulators construction, nodes for the formation of harmonic signal and digital-to-analog conversion, and so on.

**Novelty.** The scientific novelty of the obtained results is that the ways of the perspective digital frequency synthesizers development have been researched on the basis of the literary sources analysis.

**Practical Significance.** Digital frequency synthesizers are frequently used in modern control systems, radio systems, such as cellular communication devices, precision measuring instruments, radar systems and navigation. The actual material, the conclusions of the article can be used by developers to create perspective digital frequency synthesizers.

**UDC 621.432.3**

### **CHIP-TUNING METHOD OF ELECTRONIC CONTROL SYSTEMS OF THE AUTOMOTIVE INTERNAL COMBUSTION ENGINE**

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**Research Methodology.** The software and hardware packages for the electronic chip tuning of the internal combustion engine control has been analyzed. Among the many characteristics of the engine we have selected the parameters that characterize the engine power, the moment of power and the fuel efficiency to determine the correction factors at the chip tuning of the electronic control unit of the car engine.

**Results.** In this work the technique of carrying out of chip-tuning of an automotive internal combustion engine with the use of indicative efficiency of the engine from the change in load and rotational speed of the crankshaft of the engine has been suggested, as well as the coefficient of excess air from the moment of engine power and fuel consumption.

**Novelty.** The scientific novelty is in the new approach to the chip tuning of the electronic control unit of the internal combustion engine of the car. Using the characteristics of a particular engine reduces the time to obtain the optimal performance of the chip tuning of the car engine.

**Practical Significance.** The suggested method is used in the educational process for the training of chip-tuning specialists at the Department of Computerized Automation Systems at the Lviv Polytechnic National University. The technique can be used at maintenance stations during the repair and chip tuning of electronics of the car engine.

UDC 004.9:534.843

**DESIGN OF OMNIDIRECTIONAL SPEAKER FOR AUTOMATION OF  
ACOUSTIC MEASUREMENT PROCESS**

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**Research Methodology.** A fast Fourier transform and a sound signal analyzer with a built-in spectrum analyzer have been used, which allowed to study the acoustic characteristics of the designed omnidirectional speaker.

**Results.** An experimental study of the acoustic characteristics of the designed sound source using the Svan958A spectroanalyzer has been performed, which confirmed that the designed sound source can be used to study the T20, T30 time of reverberation, sound insulation and absorption coefficients of materials.

**Novelty.** The method of conducting acoustic measurements has been improved by designing a remote control for the omnidirectional speaker which made possible to carry out experiments by one person. It requires at least two people to conduct experiments with no remote control.

**Practical Significance.** The omnidirectional speaker with remote control has been designed and built which made possible to measure the reverberation time, sound insulation and sound absorption of materials.

UDC 004.49+004.67+004.633

**DESIGN OF THE WEB INTERFACE OF THE REVIEWER  
OF CONFIDENTIAL LIBRARY FUNDS**

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**Research Methodology.** The methodological basis of the study is the principles of constructing web interfaces to display typical content, based on research experiences, impressions that the user gets from the use of the interface.

**Results.** The study provides the methods and basic principles for constructing a graphical user interface of the Web client for the electronic library viewer computerized library information system. The set of interconnected methods of designing interfaces of web-clients has been presented. The concepts of UI and UX viewer library resources have been defined and expanded.

**Novelty.** The scientific novelty of the obtained results is the development of the original method of designing a web client for the electronic library viewer computer library system. Funds protection from unlawful, unlicensed copying has been developed.

**Practical Significance.** We have designed and expanded the capabilities of the web client of the e-library browser of the computerized library information system. The web interface of the search subsystem for the content of the publication, the search subsystem on the content of the publication, the mode of viewing the content for people with color blindness, the subsystem of listening to audio books have been suggested.

**UDC 655.533**

**PROBLEM OF STANDARDIZATION OF GRADATION REPRODUCTION  
PARAMETERS IN THE BORDER AREAS OF TONE RANGE OF RASTER  
IMAGES IN OFFSET AUTO-TYPE REPRODUCTION**

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**Research Methodology.** The methodological basis of the study is made by the auto-type toner reproduction of images in offset and other types of printing. To solve this problem, a set of Negebauer equations used for modeling of color printing systems and intended for the prediction of color of raster images has been used, the comparative statistical analysis of color and spatial characteristics of photos and digital printing plates and imprints from them has been done, obtained in normalized technological conditions on different printing enterprises, for their conformity to the standard ISO 12647-2: 2013.

**Results. On the basis of theoretical and experimental research,** the regulatory requirements and tolerances for the target parameter calculated within border sections, using for this the value of the ratio of the color difference in the imprint  $\Delta E$  to the corresponding change in the tone  $\Delta S$  on the digital photo or printing plate -  $g = \Delta E / \Delta S$ . The required color values are calculated according to the formula CIE76: in the area of light tones - between the area of clean paper (0%) and the areas with raster elements with tone values from 2 to 10%, and in the area of shadows - between the area of the dash (100%) and the areas with raster elements with tone values from 90 to 98%. It has been established that in order to achieve the acceptable reproduction quality of raster images, it is necessary that the numerical value of the studied gradient parameter should be within the limits of  $g = 0,6 \pm 0,1$ , regardless of the raster lines, type of paper, etc.

**Novelty.** A new method has been suggested to the ISO 12647-2: 2013 standard for controlling the transfer of gradation of raster images in the border areas of light tints and shadows of raster reproduction in offset printing, based on the normalization of the gradient parameter in which the input and output indicators of the printing process are interconnected and holistic.

**Practical Significance.** We have achieved the normalization of the parameters of ISO 12647-2 used in providing the documented compliance in assessing the correct reproduction of the border areas of the tone range of offset printing, which is carried out during the standard colorimetric procedure for profiling the processes of printing production without the use of additional micrometric or spectrometric measurements.

**UDC 541.14**

**RESONANCE INTERACTION MODELS IN LASER CONTROL OF  
EVAPORATION DYNAMICS OF THE CHEMICAL COMPONENT OF  
GLUE IN THE PROCESS OF PRINTING PRODUCTS DRYING**

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**Research Methodology.** To solve the problem, such methods have been used: the system analysis of the concentrator structure, remote laser sensing to select data on the level of concentration of vapors in the drying process, the information technology for processing laser signals.

**Results.** A structural scheme has been developed and the method of controlling the concentration of vapors during the drying of book blocks has been substantiated and the degree of removal of moisture from the material has been estimated.

**Novelty.** Based on the method of laser remote sensing, the basic concepts of creating the laser information measuring systems for determining the level of concentration of glue components and water vapor, which are isolated during the drying of book blocks, have been developed. The information technology for processing laser signals, which carry the information about the parameters of concentration of reagents in the technological environment of the dryer, is the basis for the creation of innovative technologies in the printing press.

**Practical Significance.** The article deals with the laser technologies for controlling the concentration of harmful substances evaporation during the glue

drying, which is the basis for the analysis of the regime of thermodynamic exchange with the adhesive structure of the book block. This allows you to control and select the drying mode more effectively, reduce the drying time of the block and ensure higher product quality.

UDC 535.37

### LUMINESCENCE OF NaI-LaI<sub>3</sub>-CE CRYSTALLINE SYSTEM

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**Research Methodology.** Lanthanum halides activated by cerium ions are characterized by scintillation properties, and today they are the basic material for the manufacturing of high-energy radiation detectors. However, such crystals are strongly hygroscopic, which complicates the technology of their manufacturing. As a solution to the problem of hygroscopicity of samples, it has been suggested to use LaI<sub>3</sub>-Ce microcrystals embedded in a dielectric matrix.

**Results.** The Stokbarger-Bridgman method obtained a crystalline system based on LaI<sub>3</sub>-Ce microcrystals embedded in the NaI matrix. Spectral-luminescent measurements of NaI-LaI<sub>3</sub>-Ce crystalline system using synchrotron radiation have been performed. The method of scanning electron spectroscopy detected LaI<sub>3</sub>-Ce microcrystals in the size of 1-10 μm, inlaid in the NaI matrix.

**Novelty.** The surrogate mechanisms of the excitation energy transfer to cerium centers from the NaI matrix and LaI<sub>3</sub> microcrystals have been established. The spectral-luminescence parameters of the LaI<sub>3</sub>-Ce microcrystals are identical with their bulk analogues.

**Practical Significance.** Inlaying of the LaI<sub>3</sub>-Ce microcrystals into a non-hygroscopic or less hygroscopic cubic symmetry matrix allows for obtaining samples of large sizes in comparison with single-crystals LaI<sub>3</sub>-Ce. In this case, the spectral-luminescent parameters of the crystalline system are preserved.

UDC 536.5+004.42

**SYSTEM OF DETECTION OF HIDDEN DEFECTS IN SURFACE LAYERS  
USING THE METHOD OF NON-MECHANICAL CONTROL**

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**Research Methodology.** These measurements were a continuation of the previous studies mentioned in the relevant patent applications of the Ural Technological University - the “metallic visualization grid” [1] of the Lviv Polytechnic National University - “Ceramic Grid” [2] and the Rzeszow University “airflow”, [3] concerning the explanation of the propagation of temperature in the flow of a gaseous coolant. The study has used a method of infrared non-destructive testing (IR-HK). The essence was the practical analysis necessary to eliminate the registration errors that may arise due to the lack of experience of the operator of the diagnostic law or the deviation of the parameters of the flow control of the coolant.

**Results.** An analysis of the estimation of surface parameters from the process of their registration in the correlation with changes in the energy flow (heat) brought to it by it was brought up by bringing the energy gradients to the studied surface.

The efficiency of using as a sensor, a grid (in the form of 1D, 2D, 3D models) is shown for the estimation of energy (in the form of heat transfer) and stereographic (determination of the direction of the energy carrier stream, as well as the angle of contact with the investigated surface) of the parameters of the heat flux of energy.

**Novelty.** The analysis of the surface condition in the form of deviation of heat conductivity by the method of infrared non-destructive testing (IR-HK) has been done, based on the use of two techniques - thermal and flash. The essence of the method, in particular the control of hidden defects, is to determine the corresponding thermodynamic values of the energy (thermal) field of the surface, which allows defects to be detected by establishing controlled values of parameters, in particular the energy density of the fluctuating flood brought to the surface (temperature and pressure in the case of gas flow), so that the test sample did not collapse.

**Practical Significance.** The practical value is to improve the thermal imaging method for estimating defects occurring in the surface layer, where this assessment is carried out by thermal imaging deviation (deviation) of the thermal energy flux from the investigated layer, which is accumulated in it as a result of supplying the energy flow with fixed (controlled) parameters.

UDC 681.325

**BENCHMARKING OF CAMERA-BASED RESPIRATION  
MONITORING ALGORITHMS**

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**Research Methodology.** The methodology of this study combines general scientific methods such as analysis, synthesis, modelling, system and visual methods, as well as specific scientific methods, namely, optimization methods, filtration methods and the method of expert evaluations.

The use of all these methods has allowed revealing the following aspects of scientific research, such as analysis of metrics of evaluation of signals according to existing criteria; analysis of optimization methods, synthesis of research model and visualization of research results.

**Results.** In the conducted research the fundamental principles of work of the proposed algorithms have been analyzed, in particular, it has been emphasized on their actually different methods and objects of the reached signal (subpixel offsets and photoplethysmography). The optimal metrics for qualitative estimation of algorithms have been determined, and their experimental realization has been carried out. The computationally efficient algorithms for receiving breathing signals from the video stream have been initialized and evaluated. The obtained results have been worked out and the corresponding conclusions have been made.

**Novelty.** It reveals scientific and practical potential, since such methods and algorithms have no analogues, but they are widely gaining popularity abroad. However, for the first time, such a wide range of algorithms has been studied simultaneously under various measuring conditions.

**Practical Significance.** This work is significant because reliable, remote measurement of respiratory rate is still unsatisfied with the need for clinical and home conditions. The proposed algorithms operate on the basis of the camcorder and are designed to measure breathing indices without any contact with the body. In addition, the camera provides easy access to motion information in the analyzed datasets, which greatly improves the classification of the breath at the same time. Sensory system performance was evaluated using data from healthy volunteers, in laboratory conditions, covering a large number of complex measurement situations. The obtained theoretical and experimental results can be used in the development of hardware and related software.



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## CONTROLLING THE CHANNEL OF BLACK INK IN DIGITAL TECHNOLOGIES OF COLOUR SEPARATION

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**Research Methodology.** The methodological basis of the research consists of modern methods of digital image processing based on the data of colorimetric measurements of the colour characteristics of imprints, methods of statistical processing of experimental data for measuring the colour characteristics of imprints using a package of special programs for calculations.

**Results.** The features of the various mechanisms of the replacement of the colour inks by black in the process of colour separation of images have been considered. Experimental curves have been constructed. They characterize the methods of generating the black ink when preparing images for offset printing on coated paper according to standard ISO 12647-2 with ECI profiles. The features of the replacement of the achromatic component of the triad synthesis in various technologies of colour separation have been researched.

**Novelty.** The scientific novelty of the obtained results is that the analysis of methods of generating the channel of the black ink in the implementation of colour separation of digital images has been done. On the basis of experimental studies, the mechanism of control of the black ink channel for conversion to the CMYK model has been conducted. The analysis of methods of replacement of colour inks in black, which are in ECI profiles, has been done.

**Practical Significance.** The research has been carried out using \*.ICC files of colour profiles of printing systems that meet the commercial and special offset standards of ISO 12647-2. The analysis of results allows practitioners to use the information provided when preparing images for printing on coated paper.