

## ABSTRACT AND REFERENCES

## INFORMATION AND CONTROLLING SYSTEM

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**VALIDATION OF AN INTEGRATED CONTROL SYSTEM WITH IMPROVEMENT IN EFFICIENCY AND RELIABILITY OF THE DECISIONS MADE FOR MONITORING (p. 4-11)**

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A technique is proposed to improve reliability of data from the remote RGB measurements in order to shorten the time needed for determining local leakages in the main pipelines during monitoring. To improve spatial resolution and geometrical accuracy in the RGB measurements, it is proposed to use the IR and panchromatic measurements in combination, using controlled liquid crystal filters. In this case, visualizing the IR data (employing conditional colors) and comparing them with the data of actual colors in the RGB measurements is used to improve accuracy of data from the remote measurements.

We also developed a technique for the remote and locally synchronous ground-based measurements to validate and correct their results with a certain error, which allows rapid assessment of the condition of examined area based on data from the remote measurements taking into account a validation by possible ground-based measurements.

In this case, the designed structure of an automated system simultaneously monitors main production processes and assesses ecological condition of the corresponding sites, thus addressing the set task in a comprehensive manner.

The results obtained improve efficiency of determining local leakages and the boundaries of plots, polluted in varying degree as a consequence of manufacturing processes, and facilitate making a correct decision while monitoring the environment.

**Keywords:** ecological monitoring, synchronous measurements, infrared and visible range, reliability, visualization.

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**A SUPPORT OF METROLOGICAL TRACEABILITY OF INDUCTANCE MEASUREMENTS IN UKRAINE (p. 12-18)**

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The comparative analysis of the results of the RMO international supplementary comparison of national standards of the units of inductance is conducted with the aim of evaluation of convergence. For the comparison, the reference values with the expanded uncertainties are calculated and the degrees of equivalence of standards of participants and expanded uncertainties for the nominal values of measures of 10 mH and 100 mH on a frequency of 1 kHz are determined. Metrological traceability of the national standard of every participant of comparisons to the units of the International system of units SI is determined.

For verification of consistency of the results of comparisons, the values of the  $\chi^2$  criterion for the results of comparisons of standards of participants taking into account the measurement uncertainty are calculated. The obtained values of the criterion of consistency for the participants can be considered consistent, which is the objective confirmation of the measurement uncertainties declared by the participants.

The evaluation of calibration and measurement capabilities of Ukraine for the unit of inductance is realized. The methodology of evaluation of measurement uncertainty in a wide range of inductance values (from 10  $\mu$ H to 100 H) is proposed. The results of the calculations of the values of measurement uncertainties according to the proposed methodology revealed that the results correspond to the data published in the international key comparison database for

Ukraine in the range of capacitance values from 10  $\mu\text{H}$  to 10 H on a frequency of 1 kHz.

**Keywords:** comparison of standards, metrological traceability, inductance, national metrology institute.

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### THE DEVELOPMENT OF THE METHOD OF MULTIFACTOR AUTHENTICATION BASED ON HYBRID CRYPTOCODE CONSTRUCTIONS ON DEFECTIVE CODES (p. 19-35)

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The proposed security mechanisms in hybrid-crypto-code systems, based on Niederreiter and McEliece modified asymmetric crypto-code systems on flawed codes allow further use of the methods of strict two-factor authentication on OTP passwords (OTP based 2FA). To ensure the required security and efficiency in the multi-factor authentication protocol, the McEliece and Niederreiter modified asymmetric crypto-code systems, allowing integrated reliability provision in information transmission on the basis of error-correction coding on elliptic codes are used. The use of the MV2 algorithm ensures an increase in the total entropy of the key and the physical separation of the transmission of the authenticator parts by various mobile/Internet communication channels based on multi-channel cryptography systems on flawed codes. The proposed mathematical models and algorithms for the practical implementation of the Niederreiter and McEliece HCCSFC make it possible to significantly reduce the energy capacity of group operations by reducing the power of the Galois field to GF 24–26 by additional transformations based on the MV2 algorithm, ensuring the required cryptographic strength.

**Keywords:** McEliece and Niederreiter hybrid crypto-code systems on flawed codes, multi-factor authentication.

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## MANAGEMENT OF INFORMATION PROTECTION BASED ON THE INTEGRATED IMPLEMENTATION OF DECISION SUPPORT SYSTEMS (p. 36-42)

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We developed the method and the model for managing protection of objects of informatization, based on the integrated implementation of decision support systems for the tasks on cybersecurity. The proposed solutions differ from the existing ones by the possibility to automate the procedure of generating variants for controlling actions using the decision support system, designed as a web application. The described model for the coordination of experts' opinions is based on the Delphi method. The approach proposed makes it possible to coordinate expert opinions, including to take into account different interval estimates of the degree of protection and information security metrics of the objects of informatization.

Results are presented of testing under actual conditions at the enterprises of Ukraine the software complex "Decision support system for managing cyber security of an enterprise – DMSSCSE". The DSS is adapted for the on-line work of experts. It was established that the DSS "DMSSCSE" makes it possible to improve effectiveness of the applied organizational and technical measures to protect objects of informatization. The proposed solutions enabled bringing down the cost of organizing comprehensive information protection systems by 12–15 % compared to the existing methods.

**Keywords:** cyber security, object of informatization, decision support system, expert assessment, Delphi method.

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**RESEARCH INTO DYNAMICS OF SETTING THE THRESHOLD AND A PROBABILITY OF IGNITION DETECTION BY SELFADJUSTING FIRE DETECTORS (p. 43-48)**

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A general analysis of self-adjustment algorithm of fire detectors for early guaranteed ignition detection was carried out. It was shown that step magnitude in the algorithm of self-adjustment of fire detectors can be a fixed or a selected variable, depending on the level of registered actual data about the factor of ignition of combustible material. Specific features of fire detectors, self-adjusting by ignition, relate to a non-linear nature of the algorithm and conditions for providing guaranteed ignition detection. In this case, for effective self-adjustment of fire detectors, it is expedient to set the initial threshold value by registered actual data in the absence of ignition and to regulate the adaptation step size in a special way. It was shown that the fact of an increase in self-adjusted threshold relative to its original value can be a sign of ignition detection. For probabilistic assessment of the fact of ignition detection, it was proposed to use exponential smoothing of characteristic function, which allows generation of dynamic assessment of probability of ignition detection.

A study of dynamics of self-adjusting threshold and probability of ignition detection indicate capability of self-adjusting fire detectors to provide early guaranteed detection of different sources of ignition of flammable materials under conditions unknown in advance.

**Keywords:** self-adjusting fire detector, self-adjusting threshold, guaranteed ignition detection, combustible material.

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**DOI: 10.15587/1729-4061.2017.109904****SEGMENTATION OF THE IMAGES OBTAINED FROM ONBOARD OPTOELECTRONIC SURVEILLANCE SYSTEMS BY THE EVOLUTIONARY METHOD (p. 49-57)****Igor Ruban**Kharkiv National University of Radio Electronics,  
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The essence of the simpler evolutionary method of image segmentation which relates to ant methods was set forth. The image segmentation process was presented as a set of areas in which agents (ants) move. Probability of transition from one turning point of the route to another was determined taking into account attractiveness of the route and concentration of pheromones on it. A timely convergence of decisions (choice of the same route by the agents) is processed by the use of feedback, i. e. evaporation of pheromones. The parameters setting pheromone weight and attractiveness of the area were calculated. The routes which are the most attractive according to the selected criteria (with the maximum concentration of pheromone) were determined. Unattractive routes disappear with a gradual “drying” of pheromone on such routes. When checking

function ability of the simpler evolutionary segmentation method, it was found that implementations of this method with obviously unsuccessful results are possible.

Essence of the advanced evolutionary method of image segmentation as improvement of the simpler evolutionary method was outlined. In the improved method, only the best agents increase the level of pheromone on their routes. The level of pheromone on the routes is limited. An expression has been obtained for renewal of pheromone levels. The best route may be either the iteration best or the best-so-far (found since the start of the method) route.

In contrast to the simpler evolutionary method, an optimal route of agent movement was found during segmentation of images in all implementations with the use of the advanced evolutionary method.

Experimental studies of segmentation of the images obtained from the onboard systems of optoelectronic surveillance using the evolutionary method have been carried out. As an example, possible objects of interest were defined in the segmented image and it was established that the outlined contours of the main objects of interest coincide with the boundaries of the objects in the original image. Presence of a large number of outlined contours of small-sized objects in the segmented image was pointed out and an example of such area was given. Visual estimation of efficiency of application of the evolutionary method was made.

**Keywords:** image segmentation, evolutionary method, onboard system, optoelectronic surveillance, object of interest.

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**THE PROCEDURE FOR DETERMINING THE NUMBER OF MEASUREMENTS IN THE NORMALIZATION OF RANDOM ERROR OF AN INFORMATION MEASURING SYSTEM WITH ELEMENTS OF ARTIFICIAL INTELLIGENCE (p. 58-67)**

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Features of estimation and normalization of random components of the errors occurring in measurements with the help of goniometric systems were considered. A general procedure has been formulated that makes it possible to soundly determine the necessary and sufficient number of measurement repetitions to ensure accuracy and reliability of the obtained results. The procedure is based on application of mathematical apparatus of the probability theory, mathematical analysis and statistics, as well as the assumption that random errors obey the normal law of distribution of random quantities. Operatiability of the proposed procedure and effectiveness of its use have been experimentally confirmed. In particular, when comparing the obtained results with those in a similar work [7], the time taken to carry out measurements decreased by 1.3 times. That is, the effect of applying the proposed procedure is greater than the measurement costs while a high accuracy of 0.01<sup>2</sup> and reliability of 0.95 are maintained. The obtained results indicate the possibility of further extensive laboratory and industrial applications.

**Keywords:** artificial intelligence, goniometric system, random component of the measurement error, mathematical statistics, mathematical analysis, probability theory.

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**DEVELOPMENT OF STRATIFIED APPROACH TO SOFTWARE DEFINED NETWORKS SIMULATION (p. 67-73)**

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The stratified approach to software defined networks simulation has been proposed. It is based on Discrete Event System Specification formalism, atomic and coupled models concepts usage. The approach is aimed at simulation within the Windows environment, with an accent on the easiness of model reconfiguration. The proposed approach is also devoted to simulation-related overheads decrease. The atomic models of active (controller, switch, host) and passive (link) network components have been proposed. The coupled model of a software defined network comprising atomic models of active and passive components has been proposed. The estimations of the resulting coupled model complexity, with respect to the number of components basic atomic models, have been given. During experimentation, the pingall command usage scenario has been considered. For this purpose, the emulation via Mininet environment and the simulation on a basis of the proposed approach have been conducted. It has been shown that discrete-event simulation on a basis of the proposed approach is significantly less time-consuming. During the approach usage within the Windows environment, the absence of the need to utilize the Xming X Server and PuTTY utility for the purpose of visualization has been faced. The validity of the approach has been proven on a basis of the obtained experimental data. The adequacy of the resulting coupled simulation model of the network

has been proven with t-criterion. The proposed approach can be used for the purpose of software defined networks validation with an accent on non-functional properties.

**Keywords:** Software Defined Network, Simulation, Discrete Event System Specification, Big Data.

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