ABSTRACT AND REFERENCES

INFORMATION AND CONTROLLING SYSTEM

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CONSTRUCTION OF HYBRID SECURITY SYSTEMS BASED ON THE CRYPTO-CODE STRUCTURES AND FLAWED CODES (p. 4-21)

Serhii Yevseiev
Simon Kuznets Kharkiv National University of Economics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-1647-6444

Olga Korol
Simon Kuznets Kharkiv National University of Economics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-8733-9984

Hryhorii Kots
Simon Kuznets Kharkiv National University of Economics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-4588-8739

In order to ensure safety of SCCI, it is proposed to use hybrid crypto-code constructions based on the modified asymmetric crypto-code McEliece systems on flawed codes, which make it possible to obtain maximum quantity of emergent properties at minimal resource cost for initiating in the system the synergistic effect of security provision. The main difference from known approaches to the construction of hybrid cryptosystems is the use of MCCS instead of symmetric cryptosystems; to strengthen resistance and to "reduce" the alphabet power (dimensionality of field GF(26–28) to build the McEliece MCCS), the systems on flawed codes are employed.

The algorithms proposed in present work for the formation and decryption of a cryptogram in the hybrid cryptosystem based on MCCS on flawed codes make it possible to practically implement HCCSFC. The study that we conducted into energy consumption of major operations in the hybrid cryptosystems and their stability on the basis of the proposed assessment procedure confirms efficiency of their application in order to provide basic requirements to service quality in IES.

Keywords: hybrid cryptosystems, asymmetrical crypto-code construction, algebraic geometric codes, flawed codes.

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IMPROVEMENT OF CONTROL METHOD OVER THE ENVIRONMENT OF COGNITIVE RADIO SYSTEM USING A NEURAL NETWORK (p. 22-28)

Yaroslav Obikhod
OOO «Soft Review», Kyiv, Ukraine
ORCID: http://orcid.org/0000-0003-1186-9599

Volodymyr Lysechko
Ukrainian State University of Railway Transport, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-1520-9515

Yuliia Sverhunova
Ukrainian State University of Railway Transport, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-5909-3606

Oleksandr Zhuchenko
Ukrainian State University of Railway Transport, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-3275-810X

Oleksiy Progonniy
Ukrainian State University of Railway Transport, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-4777-0729

Georgiy Kachurovskiy
Ivan Kozhedub Kharkiv University of Air Force, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-1141-0465

Viacheslav Tretijk
Ivan Kozhedub Kharkiv University of Air Force, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-2599-8834

Volodymyr Malyuga
Ivan Kozhedub Kharkiv University of Air Force, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-6227-1269

Valeriy Voinov
Ivan Kozhedub Kharkiv University of Air Force, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-5732-5960

In the course of present research, we examined a method to control the environment of a cognitive radio using a PNN neural network as a decision-making system. As a result of research into the WRAN environment control architecture using a neural network, a flow chart of the environment control algorithm has been developed. Its special feature is that a neural network is located at each base station and interacts with other WRANs according to the IEEE 802.22 standard. The cognitive radio environment control architecture has been improved using a PNN network. This is achieved by applying a special case of radial basis networks – a probabilistic neural network and a hybrid learning system, as well as a hybrid form of error correction and accumulating the experience of past iterations.

To simulate a PNN neural network, the MATLAB software package was selected using standard functions of “Neural” and “Simulink” sections. To determine the two measurable vectors of the input set, four domains of input vectors with a normal distribution law with arbitrary values have been created. As a result of the network simulation, a connectivity matrix corresponding to the input vector has been generated.

A PNN neural network simulation showed statistically confirmed results. The network has one competing layer and a layer for receiving and splitting the attributes of the input vector. This ensures the use of a small number of network neurons and, accordingly, the fast learning ability of the network – 1200 ms, which is 1.67 times faster than the required value, which is achieved by employing parallel processing of information.

Moreover, the improved method provides the ability to work in the presence of a large number of uninformative, noise input signals, as well as the adaptation to environmental changes.

Keywords: cognitive radio, architecture, radio frequency resource, neural network, probabilistic neural network.

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DEVELOPMENT OF A SPATIAL METHOD FOR THE ESTIMATION OF SIGNAL STRENTH AT THE INPUT OF THE 802.11 STANDARD RECEIVER (p. 29-36)

Dmytro Mykhalevskiy
Vinnytsia National Technical University, Vinnytsia, Ukraine
ORCID: http://orcid.org/0000-0001-5797-164X

We proposed a spatial method for the evaluation of signal strength at the input of the receiver for the 802.11x family of standards. For this purpose, an analysis was conducted of the basic energy characteristic for any wireless channel of the 802.11 standard and a model of the signal distribution was derived. The advantage of this method is the ease of implementation and the possibility to take into account a maximally possible number of destabilizing factors that can be relevant for a particular room.

Based on the experimental evaluation of spatial distribution of strength for a typical room and for a corner placement of access point, we received a universal mathematical model and permissible limits of its change.

It was established that the level of signal fluctuations indoors is affected by such basic independent components: reflected signals from the room surfaces, interference obstacles and noise. In the frequency range of 2.4 GHz for the 802.11 standard, there occurs a rather heterogeneous distribution of signals in the room with the creation of amplification and weakening regions with a difference of up to 10 dBm, and under the most difficult conditions – up to 25 dBm. It was also established that the heterogeneity of signal distribution increases proportionally to the number of reflective surfaces in a room, which is additionally enhanced by the presence of interference obstacles and noise.

Keywords: a wireless channel of the 802.11 standard, signal strength distribution, multibeam wave propagation.

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ESTIMATION OF ACCURACY IN DETERMINING THE TRANSLATIONAL VELOCITY OF A VIDEO CAMERA USING DATA FROM OPTICAL FLOW (p. 37-45)

Andrii Molchanov
M. E. Zhukovsky National Aerospace University
"Kharkiv Aviation Institute", Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-8325-7914

Vyacheslav Kortunov
M. E. Zhukovsky National Aerospace University
"Kharkiv Aviation Institute", Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-3960-6037

Rahman Mohammadi Farhadi
M. E. Zhukovsky National Aerospace University
"Kharkiv Aviation Institute", Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-9038-8154

The devised approaches are adapted to the complicated conditions of observation in certain real tasks, and are fully operational in those cases when existing standard algorithms fail to give reliable results. We propose a method for determining dynamic motion parameters based on the algorithm of a dense optical flow using a texture analysis. In order to determine an optical flow, we employed a block mapping method that uses adaptively variable size and adaptive motion vector search strategy with weighting the measurements of image blocks, where each block is matched with a texture indicator. A standard block method for estimating optical flow does not imply the use of weighting of the image blocks. A measure of the image block texturization and, consequently, the reliability of the computed motion vector, is determined on the basis of conditionality number of the information matrix. Based on the calculated optical flow, in order to estimate motion parameters, it is proposed to use the least square method that takes into account noise of the measured data. In this case, the minimization is applied at which a contribution to an error is weighed, greater importance is given to the points where the optical flow speed is larger. This is most useful when the measurement of high speeds is more accurate. The norm that produces the best results depends on the noise properties in the measured optical flow. When estimating parameters of the translational motion velocity of the entire image frame, the proposed method considers textural differences of the underlying surface, as well as noise in the measured data of each image block.

We presented simulation results of a UAV motion along different types of the underlying surface and estimated the accuracy of determining translational motion parameters using the optical sensor. Experimental results confirm that the application of a texture analysis when evaluating a motion field improves performance by recruiting a reduced number of vectors, as well as this proves to be more accurate in comparison with traditional block brute-force methods.

Keywords: UAV, optical navigation, dense optical flow, motion field, motion parameters.

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DEVELOPMENT OF SOFTWARE FOR COMBINING FINITE ELEMENT AND OPTICAL ANALYSES (p. 46-53)

Valentin Kolobrodov
National Technical University of Ukraine
«Igor Sikorsky Kyiv polytechnic institute», Kyiv, Ukraine
ORCID: http://orcid.org/0000-0003-0941-0252

Dmytro Pozdniakov
National Technical University of Ukraine
«Igor Sikorsky Kyiv polytechnic institute», Kyiv, Ukraine
ORCID: http://orcid.org/0000-0002-1376-3934

Vyacheslav Sokurenko
National Technical University of Ukraine
«Igor Sikorsky Kyiv polytechnic institute», Kyiv, Ukraine
ORCID: http://orcid.org/0000-0001-5057-182X

Volodymyr Tiagur
National Technical University of Ukraine
«Igor Sikorsky Kyiv polytechnic institute», Kyiv, Ukraine
ORCID: http://orcid.org/0000-0001-5306-011X

In the process of development of numerous optical systems of aerospace designation, it is necessary to take into account deformations that arise in the optical and mechanical elements of the structure. Such deformations can occur due to loads, vibrations, impacts, temperature effects, and other factors. Their consideration in system development will enable prediction of influence of external factors on the final optical image quality. However, it is impossible to directly import results of finite element analysis into optical programs.

A special computer program Deform was developed, which makes it possible to link programs for finite-element and optical analysis. The general idea is to determine parameters of the shape and spatial orientation of the spherical or aspherical “basic” surface, which is most closely approximated to the deformed surface for a specified set of surface points. Next, approximation of the deformation function of higher order is carried out.

Operability of this software has been proven during development of means for a three-mirror anastigmattic quasi-orthoscopic lens. With the help of parametric simulation, a study was carried out on the influence of geometric parameters of lightening and fastening on deformation of the working surface of extra-axial segments of axisymmetric mirrors. As a result of this study, an option of lightening and fastening was selected, which minimized deformation of the working mirror surfaces. The results of simulation of impact of gravity on nonlightened and lightened mirrors, which was carried out in ANSYS Workbench, were then imported into ZEMAX optical analysis program for obtaining MTF charts of the system.

Keywords: Zernicke polynomials, finite element analysis, optomechanics, load simulation, mirrorweight reduction.

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DESIGN OF FIRE DETECTORS CAPABLE OF SELF-ADJUSTING BY IGNITION (p. 53-59)

Boris Pospelov
National University of Civil Protection of Ukraine, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-0957-3839

Vladimir Andronov
National University of Civil Protection of Ukraine, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-7486-482X

Evgeniy Rybka
National University of Civil Protection of Ukraine, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-5396-5151

Stanislav Skliarov
National University of Civil Protection of Ukraine, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-8959-0753

The concept of guaranteed ignition detection at a site was introduced. A criterion of optimization of guaranteed detection was formulated, which comes down to the equality of probabilities of false detection and missing of ignition source. Algorithms and structure of fire detectors, capable of self-adjusting by ignition of materials, were developed. Their distinctive feature is the possibility of being applied under uncertain conditions for arbitrary and combustible materials that are unknown in advance. To enhance effectiveness of fire detectors capable of self-adjusting by combustion of materials, we proposed adaptation of original threshold value to current observations of ignition components. For this purpose, it was proposed to use the procedure of median filtration of recorded data.

As a parameter of convergence of the procedure of threshold self-adjustment, we consider a fixed and dynamic way of its determining. This makes it possible to provide adjustment of original convergence of procedures toward observed components of combustion of various materials. Verification of the proposed self-adjusting fire detectors indicates their capability to provide guaranteed detection of sources of ignition for various materials at the early stages under conditions unknown in advance.

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

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EVALUATION TO DETERMINE THE EFFICIENCY FOR THE DIAGNOSIS SEARCH FORMATION METHOD OF FAILURES IN AUTOMATED SYSTEMS (p. 59-68)

Olena Syrotkina
National Mining University, Dnipro, Ukraine
ORCID: http://orcid.org/0000-0002-4069-6984

Mykhailo Alekseyev
National Mining University, Dnipro, Ukraine
ORCID: http://orcid.org/0000-0001-8726-7469

Oleksii Aleksieiev
National Mining University, Dnipro, Ukraine
ORCID: http://orcid.org/0000-0003-4793-6669

This paper describes the results of work in the field of failure self-diagnostics for automated systems in real time to increase the efficiency of their operation. We describe the method developed of a diagnosis search formation space by applying to the Expert System Knowledge Base to diagnose failures in automated systems. The input data for the Expert Diagnostic System is a conflicting set of diagnostic codes generated by the automated system over the time interval Δt during its operation. We proposed mathematical methods to work with a data structure "m-tuples based on ordinary sets of arbitrary cardinality n" to process the input data. We conducted a comparative analysis to estimate the execution time of algorithms for the diagnosis search formation space using sequential access to the Boolean of input data and using the method developed. The analysis showed that the application of the proposed method changes the functional dependency of the execution time estimation of the algorithm in accordance with the number of its input data n from exponential to cubic. The application of the method developed allows us to minimize the time needed to establish the diagnosis to real time. The method presented to diagnose automated systems allows creating methods and algorithms for automatic self-recovery of their operability after reversible failures in real time.

Keywords: expert diagnostic system, failure diagnostics, data organization structure, estimation of algorithm execution time.

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