Реферати

UDC 617.751

Petrov V.V., Antonov E.E., Zenin V.N., Manko D.Yu., Shanoilo S.M. Peculiarities of the formation of homogenized images by plane-focusing Fresnel lenses. *Data Rec., Storage & Processing*. 2023. Vol. 25, No. 1. P. 3–21. — Ukr.

An algorithm for simulating Fresnel microprism concentrator lenses, which forms a homogeneous image of the transmitted light rays in the focal plane, has been developed. Such flat-focusing lenses make it possible to form an optimal signal in systems of automatic control of moving objects with four-plane photodetectors, and are also promising for use in solar photovoltaic modules.

Some samples of such specified focusing microprism devices with illumination distribution of the light spot in the form of circle and ring, were made by the method of diamond microcutting technique according to our simulation results. A feature of focusing structures created by the diamond cutting technique is a discrete change in the refractive angles of microprismatic zones, resulting in the discreteness of the images formed in the focus. This is a main difference from Fresnel focusing optics with aspherical convex circular surfaces, when the angles of refraction change continuously. In the manufacture of such new devices by the diamond cutting method it is possible to obtain almost mirror working surfaces of a high optical quality. However, the size of such conical refracting zones should not be too large to reduce the discreteness of the formed images, so the new specified focusing microprisms are made from several totally identical prismatic elements.

With the help of collimated «green» laser beam, some samples of specialized transforming microprism structures were experimentally investigated, that form the uniform illumination of a light spot in the form of a light circle and a circle with a ring. Fig.: 21. Refs: 14 titles.

Using computer modelling, the profiles of transmitted light rays were found, which made it possible to identify the reasons for the additional expansion of refracted light beams.

Key words: microprismatic Fresnel lenses simulation, plane-focusing optics, microrelief structure.

UDC 004.08; 539.213; 541.67; 548.3

Rubish V.M., Hreshchuk O.M., Durkot M.O., Makar L.I., Mudry S.I., Pisak R.P., Solomon A.M., Shtablavyi I.I., Yukhymchuk V.O., Yasinko T.I. Structure and surface morphology of mercury modified selenium thin films. *Data Rec., Storage & Processing*. 2023. Vol. 25, No. 1. P. 22–31. — Ukr.

The results of investigations of the structure and surface morphology of nominally pure, crystallized and mercury modified amorphous selenium films are presented. Amorphous Se films with a thickness 500-1000 nm were obtained by vacuum evaporation of vitreous selenium from quasi-closed effusion cells on to unheated glass substrates. Crystallization of amorphous Se films was performed by their heating to a temperature of 423 K at a heating rate 6 K/min on air. Selenium films modification was carried out in special hermetic boxes by keeping them in mercury vapor for 0.5-168 hours at 283-293 K. The structure of the films was studied by the X-ray diffractometry and Raman spectroscopy methods. For the investigations of the surface morphology of modified selenium films a field emission scanning electron microscopy (FESEM) analysis was performed.

It was established that the matrix of the amorphous Se film is a mixture of Se_8 ring fragments and Se_n chains, and the structure of the crystallized film corresponded to the structure of trigonal selenium.

Exposure of the films in mercury vapor leads to the formation in the amorphous matrix the HgSe crystalline inclusions in the cubic modification, which accompanied by the appearance on the diffractograms and Raman spectrum of weakly expressed corresponding reflexes and bands. As the exposure time increases, the reflexes become pronounced, and their position agrees well with the position of intense reflexes on the diffractograms of crystalline mercury selenide obtained by the hydrochemical methods. Weakly expressed reflexes, characteristic of HgSe, were also detected in the diffractogram of mercury modified crystallized selenium film. FESEM studies of mercury modified selenium films confirm the conclusion based on the structural investigations that the phase structure formed during the modification of selenium films corresponds to the structure of crystalline mercury selenide. Fig.: 8. Refs: 22 titles.

Key words: amorphous, crystallized and mercury modified selenium films, surface morphology, structure, mercury selenide, scanning electron microscopy, X-ray diffractometry and, Raman spectroscopy.

UDC 004.622:004.822

Lande D.V., Kryuchyn A.A., Dobrovska S.V., Balagura I.V. Use of the «Library of Science Metrics» system for conducting science metric research. *Data Rec., Storage & Processing*. 2023. Vol. 25, No. 1. P. 32–42. — Ukr.

Using the example of the analysis of publication activity in the current scientific and technical direction of information protection, the capabilities of the «Library of Science Metrics» system for searching for information in the abstract database «Ukrainika Naukova» (abstracte journal «Dzherelo») are presented. The basic technologies employed in the creation of the «Library of Science Metrics» system are defined. Special attention is paid to the analysis of methods of using the «Library of Science Metrics» system. National databases of abstract information make it possible to more accurately determine the directions of research in a specific country. The database «Ukrainika Naukova» has accumulated a huge amount of information (more than 800,000 abstracts) about the research of Ukrainian scientists over a long period of time (since 1998). In order to more effectively use the capabilities of the abstract database «Ukrainika Naukova» (referential magazine «Dzherelo»), it is necessary to organize information search with the provision of analytical opportunities for information processing with further expansion of information resources, as well as analytical services that allow detection you interrelationships of research authors and explore their dynamics. It is expedient to create a system of scientific information integration based on the reference journal «Source» and to expand it by connecting other scientific databases. Based on the analysis of modern means of creating intelligent scientometric services, the modern information and search system Manticore Search (https://manual.manticoresearch.com/) was chosen as the technological basis of the proposed approach. The selected system is characterized by high speed, effective search, both using traditional SQL queries for structured data and for unstructured data based on JSON queries. Tabl.: 7. Fig.: 4. Refs: 11 titles.

Key words: «Ukrainika Naukova» (abstract journal «Dzherelo»), information search, analytical processing.

UDC 004.891.3

Biloborodova T.O., Skarga-Bandurova I.S. Separation of data sources and extraction of target components of the electrophysiological time series on the example of fetal ECG. *Data Rec., Storage & Processing*. 2023. Vol. 25, No. 1. P. 43–53. — Ukr.

Electrophysiological time series are a valuable source of information but are often presented by instantaneous unknown linear mixtures of sources. Thus, one faced the task of data extraction, canceling other sources, to identify target data components. Fetal electrocardiography is one of the most important and valuable sources of information. However, the resulting abdominal electrophysiological data is a mixed source of maternal and fetal electrocardiograms, and also muscle activity data, noises, etc. The abdominal electrocardiogram preprocessing, noise removing, cancellation of the maternal electrocardiogram while maintaining the diagnostically valuable components of the fetal electrocardiogram is the most important steps in the fetal electrocardiogram extraction from the abdominal electrocardiogram. Analyzing source separation methods made it possible to highlight the advantages and disadvantages of current techniques, and to form a sequence for electrophysiological data processing. The proposed approach consists of four stages. In the first stage, electrophysiological data are preprocessed, including the baseline canceling and removing high-frequency noise using a second-order low-pass filter with zero phase. However, decorrelation based on principal component analysis is applied. The next step based on using a source separation algorithm to target data extraction. In the fourth step, channels of non-target data are canceled through a generalized eigenvalue decomposition and periodic components analysis. Thus, components of the target fetal electrocardiogram data are extracted from the mixed data. The experiment was carried out using a record that consists of five abdominal channels and one chest lead which corresponded to maternal electrocardiogram. The results of the standard error and the signal-to-noise ratio show that the presented approach is appropriate for extracting the fetal electrocardiogram from the abdominal channels and the following analysis. Tabl.: 1. Fig.: 3. Refs: 28 titles.

Key words: source separation, blind source separation, principal component analysis, periodic component analysis.

UDC 004.89

Fedorchenko I.M., Oliinyk A.O., Stepanenko O.O.., Fedoronchak T.V., Chornobuk M.O. Development and research of a modified convolutional neural network for malaria cell pattern recognition. *Data Rec., Storage & Processing*. 2023. Vol. 25, No. 1. P. 54–64. — Ukr.

A review and analysis of known solutions of the problem of detecting malaria from images of patients' blood at the cellular level using various machine learning algorithms, including the support vector method, deep belief network, and convolutional neural networks, was conducted. Models based on neural networks demonstrate greater efficiency. In particular, all models based on Deep belief network and convolutional neural networks show a classification accuracy of more than 95 %.

It was decided to develop our own model based on a convolutional neural network, which turned out to be the most promising algorithm among those considered. In the development of the proposed solution, a publicly available set of annotated images of patient blood cells was used, which was corrected according to other work that considered this data set. The Python programming language was used in combination with the TensorFlow library, which was applied directly to develop the network. The OpenCV on Wheels library was utilized to resize images from the dataset.

The model consists of 16 layers: 5 convolutional, 5 aggregating, one dropout layer and 5 fully connected. After the development of the machine learning model, the accuracy of the model was tested and compared with the analogues discussed above. Testing was performed independently on two data sets: a set consisting of images scaled to a size of 50×50 pixels and a set consisting of images scaled to a size of 100×100 pixels. According to the test results, it was established that the model is at the level of the best considered analogs based on convolutional neural networks in terms of classification accuracy of test data, having a classification accuracy of 96,68 % and 98,08 % on a set with smaller and a set with larger images, respectively. The model reaches these values at about the fifteenth epoch of training, and the phenomenon of overtraining is observed in the following epochs. Tabl.: 2. Fig.: 4. Refs: 20 titles.

Key words: Convolutional neural network, machine learning, malaria, pattern recognition, Keras, Python.

Decision-making involves choosing a course of action from among two or more possible alternatives in order to find a solution to a problem. This means that the decision-making process seeks a goal. A goal is a predetermined business goal, a company's mission and vision. In order to achieve this goal, one can face many obstacles in the administrative, marketing and operational areas.

The investigation presents the main characteristics of the mathematical apparatus designed to compare the parameters of the available variants of possible solutions and aimed at solving the problem of choosing alternatives during the analysis of tender offers. For this, the apparatus of functional-cost analysis was applied. Functional cost analysis (FCA) is a technology that allows one to estimate the real value of a product or service regardless of the company's organizational structure. Both direct and indirect costs are allocated to products and services depending on the amount of resources required at each stage of production. Actions performed at these stages in the context of the FVA method are called functions. The purpose of the FVA is to ensure the correct allocation of resources allocated to the production of products or the provision of services to direct and indirect costs.

The implementation of the solution with the aim of choosing the optimal one, taking into account both the economic factors and the characteristics of the mathematical apparatus that affect the productivity of its work, is given. The presented research was carried out to fill the mathematical apparatus of the decision-making support system in the tasks of choosing alternatives during tender procedures. Tabl.: 6. Fig.: 1. Refs: 13 titles.

Key words: functional-cost analysis, alternative, pairwise comparison method, decision support system, mathematical apparatus, tender procedures.

In the realm of modern information systems, the security of high-risk decision support systems (DSS) handling critical data remains a pressing concern. The accuracy and reliability of DSS outcomes are heavily reliant on the integrity of the data they process, necessitating a highly secure and transparent data platform. Traditionally, many such systems have been centralized, stored in a single location, making them susceptible to data loss and tampering by potential bad actors possessed insider knowledge.

This research delves into approaches to address these security challenges by harnessing the potential of decentralized data platforms, with a particular focus on blockchain technology. By embracing blockchain and decentralized data frameworks, DSS can significantly enhance their security model and overall efficiency. The investigation provides a comprehensive overview of blockchain technology, its various types, and the consensus algorithms that underpin its operation.

Specifically, the research explores how blockchain can revolutionize the process of data entry by experts who interact with the DSS. By leveraging the inherent immutability and transparency of blockchain, data input becomes more reliable, reducing the risk of fraudulent alterations and ensuring a trustworthy decision-making process.

To tackle the issue of scalability, the research proposes a solution of storing only a fraction of the information on the decentralized ledger. This approach guarantees data verification without burdening the system with excessive storage requirements.

In summary, this research demonstrates how decentralized data platforms, particularly blockchain, hold the key to fortifying the security and reliability of decision support systems. By embracing these innovative technologies and methods, decision support systems can empower organizations to make well-informed, secure, and tamper-resistant decisions while ensuring data integrity, immutability, and fault tolerance at the platform level. Fig.: 4. Refs: 24 titles.

Key words: decision support systems, data immutability, blockchain, consensus algorithms, information security, decentralized platforms, distributed systems.