

Реферати

UDC 004; 681.7.06

Kosyak I.V., Tsubin O.A. Formation of radial optical structures on a circular laser recording system. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 3–8. — Ukr.

An analysis and research of the systems for the formation of planar optical elements has been carried out. Features of development and construction of circular laser recording systems are considered. The implementation of the formation of radial optical structures by a laser optical disk recording system is proposed.

To obtain a certain pattern on the surface of a glass substrate, the photolithography method is used, which is widely used in microelectronics and other types of micro-technologies, as well as in the production of optical encoders and coding discs. There are three types of photolithography: contact; with a gap; projection

Recently, the technology of laser lithography, the so-called method of direct laser recording in photoresist, has been developing more and more actively. This technology makes it possible to manufacture and replicate a wide range of different optical structures and micro-optical elements.

The analysis of research and publications shows that a great deal of attention is paid to the problem of developing laser lithography tools and technologies. From this follows the task of research — conducting an experimental study of recording radial optical structures on photoresist on a circular laser recording system.

The formation of radial optical structures by the method of direct laser recording was carried out on the basis of an active laser recording station, which was created at the Institute of Information Registration Problems of the National Academy of Sciences of Ukraine. With the technology of direct laser recording on a circular laser recording system, in contrast to the technology of laser recording of photo templates in Cartesian coordinates, exposure is carried out with a focused beam at very high scanning speeds of 0,3–0,6 m/s. In manufacturing the optical structure element, the substrate with the light-sensitive material rotates continuously, while the recording beam slowly moves in the radial direction from the center to the edge according to a given pattern.

An experimental study of the recording of radial optical structures by photoresist on a circular laser recording system was performed. It is shown that the developed data preparation system allows recording radial optical structures of arbitrary shape. Increasing the resolution of recording elements of optical structures and improving optical, mechanical, and electronic assemblies remain urgent tasks. Fig.: 2. Refs: 12 titles.

Key words: structure element, the substrate with the light-sensitive material rotates continuously.

UDC 004.93

Fedorchenko I.M., Oliinyk A.O., Stepanenko O.O., Zaiko T.A., Miediveidev K.V., Fedorchenko Y.V., Fedoronchak T.V., Kolpakova T.O. A genetic method for solving the problem on educational classes scheduling. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 9–23. — Ukr.

The problem of creating an optimal schedule is considered, which consists in finding the optimal distribution of educational classes for a certain period of time under given restrictions. Sequential and parallel scheduling methods based on genetic search have been developed.

The proposed methods use adapted and modified initialization, crossover, and selection operators. Algorithms, using the objective function, minimize conflicts between classes and the time interval between classes, take into account the recommended time and venue. The developed methods allow you to speed up the time for planning the educational process and avoid mistakes when creating a schedule.

A comparative analysis was conducted between the classical and modified genetic algorithm, and it was found that the modified algorithm works faster and more efficiently than the classical one. The performance of the modified algorithm was also compared with different genetic algorithm operators and parameters to determine the best ones.

The obtained results allow us to propose effective methods for improving the quality of scheduling and improving the learning process at the university. Tabl.: 5. Refs: 27 titles.

Key words: genetic algorithm, schedule, evolutionary algorithm, classes, constraints.

UDC 004.5

Senchenko V.R., Boichenko A.V., Koval O.V., Khomenko O.M., Bysko R.M. A review of methods and technologies for scenario analysis of cascading effects. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 24–54. — Ukr.

Cascading effects are complex and multidimensional processes that develop in time and space. To study cascading effects that result from various impacts to critical infrastructures is particularly relevant. Using of scenario analysis methods allows to construct and investigate as many possible scenarios as possible to track cascade processes developing. Understanding the ultimate consequences of cascading effects is important for developers of the cross-sectoral critical infrastructure protect strategy.

This study presents a systematic analysis of existing methods and technologies for scenario analysis of cascading effects from the point of view of their efficiency specifically for design of critical infrastructure protection models. The researchers tried to cover as widely as possible the most important achievements in this field over the past decades. As a result, ten promising approaches were preferred. In our opinion, the method of cross-impact analysis, interpretive structural modeling, their combination, Delphi method, dynamic modeling, risk analysis methods, network analysis method, agent modeling, modeling of geographic information systems, machine methods deserve special focus. Based on the results of the analysis, a summary table was created. It presents a brief description of each of the considered approaches, technologies and tools for its implementation, advantages compared to other approaches, disadvantages and features of usage. It is presented that computer simulation packages have been implemented for the considered methods, which allow investigating complex scenarios of cascading effects.

The knowledge obtained as a result of using considered methods will allow to improve decision making process for critical infrastructures resilience supporting and minimizing of harmful effects and attacks negative consequences. Tabl.: 5. Fig.: 7. Refs: 70 titles.

Key words: scenario analysis, cascading effect, critical infrastructure, management activity, modeling methods.

UDC 004.942:621.311

Dodonov O.G., Kuzmychov A.I. A quantitative assessment of the network structures functional resilience by analyzing of the sensitivity of an optimization model. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 55–66. — Ukr.

The real network organizational structure is constantly under the influence of external influences, which can cause unexpected consequences due to the cascading spread of relevant disturbances directed at critically important parameters.

Parametric sensitivity analysis is the latest computational procedure, the results of which provide the researcher with an idea and quantitative assessment of the appropriate response of the structure in the form of an analytical platform as a composition and interaction of scenario analysis, cascade process development and optimization modeling technology. The main task is timely adaptation to expected changes.

Network structures are a widespread form of organizational, business and industrial activities, network models of relevant objects/processes are based on mathematical, informational and computational foundations, which is an important component of higher education and the practice of general and special management and business analytics.

Examples of two typical problems of flow optimization are given: about network flows of minimum cost and about maximum flow through the network, where such a platform is built, which is used to predict the behavior of the structure and its components according to the sequential change of the influencing resource and the formation of management decisions.

The maximum flow problem is an example of the active and effective application of methods and models of flows optimization, where the processes and objects used a network organization, the energy systems and complexes are investigated, arc parameters are critical in its model.

In the work, for these classic optimization problems, mathematical and spreadsheet models were built on concrete examples, direct and dual mathematical programming problems were solved, the following stages were carried out - the organization of a computer experiment and the construction of an analytical platform for evaluating the behavior of the network structure under the influence of external influences and disturbances as their consequences. To take into account the specific conditions of real objects with a network structure at the stage of modification, the model is supplemented with appropriate restrictions and correction of input data sets. The obtained results could be useful for planning and management personnel and top-management for discussion and decision-making regarding, for example, the optimal placement of

energy equipment, the weighted distribution of energy flows in the «source-sink» system or the appointment of executors for work, automated project management using project networks, etc. Tabl.: 7. Fig.: 4. Refs: 11 titles.

Key words: optimization modeling, flow optimization, maximum network flow, mathematical programming, network organizational structures, Management Science, Decision Making, Excel Solver, Spreadsheet Modeling and Analytics.

UDC 535.421

Lapchuk A.S., Prygun O.V., Gorbov I.V., Morozov Ye.M., Borodin Yu.O. RGB laser projector with uniform speckle-free illumination based on a compact passive system of incoherent focusing. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 67–88. — Ukr.

An analysis of properties of laser projectors has shown that in spite of large advantageous of laser illumination like high optical efficiency, high optical gamut and images saturation, an interference phenomenon that demonstrates himself through interference fringes in illumination spot and in strong granular modulation of image by subjective speckle are main obstacles to wider application of laser illumination for compact optical projectors. Till now, in spite of large effort for suppression of interference effects in laser illumination system the known solutions are not sufficiently simple, efficient and compact for small optical projectors. An analysis of the mechanisms for subjective speckle suppression in RGB laser projectors has shown that for obtaining a compact speckle free passive laser illumination system with uniform illumination requires simultaneous reduction of temporal, spatial, and polarization coherence of the illumination laser beam, along with light intensity homogenization. In addition, a simplest illumination system should not have active optical element. A compact passive optical scheme based on incoherent focusing of the laser beam using two 1D arrays of prisms with varying heights that focused a laser beam in one rectangular shaped homogeneous laser spot is proposed. In proposed optical scheme a decrease of time coherence of laser illumination is achieved by using two wideband lasers with orthogonal polarization. The system also has depolarization module of laser beam to use polarization for speckle suppression. An additional passive optical diffractive element (DOE) employing a pseudo-random binary sequence is used to enhance speckle reduction and improve uniform illumination quality. It is demonstrated that such a system can be assembled using readily available laser light sources and optical elements, and its operational principle is experimentally validated. Fig.: 12. Refs: 57 titles.

Key words: speckle, speckle reduction, laser projector, incoherence, incoherent focusing systems, focusing prism, multi-retarder prism.

UDC 004.5

Dodonov O.G., Nikiforov O.V., Putyatin V.G., Dodonov V.O., Kutsenko S.A., Germaniuk A.P. Territorially distributed information computer systems in a unified information space: basic concepts and definitions. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 89–112. — Ukr.

The study discusses the main basic concepts describing territorially distributed information computer systems that function in a unified information space, and their definitions are given. The defined basic concepts are used in the study of various aspects of the structural and functional construction of such systems.

Territorially distributed information computer system in a unified information space (TDICS UIS) is defined as a complex territorially-distributed system consisting of a set of organizational structures, software-technical and telecommunication tools, functioning mechanisms, algorithms, technologies, databases and data banks and of knowledge that work in a unified information space and are designed to collect, process, store and provide the necessary information to system users to make timely and adequate decisions.

A unified information space is understood as a set of relevant and integral information resources organized according to the single principles and rules of formation, formalization, storage, technology of their management and use, which ensure the possibility of coordinated functioning. of all system elements and is designed to meet the information needs of system users. The creation of a unified information space should provide all users with a single view of the information objects that form the information model of the specified subject area.

Various aspects of the construction and functioning of this class of systems have been studied: purpose, main functions, tasks and properties of the system; purpose and properties of a unified information space; information processes occurring in the system; interaction of the system with the external environment; types of security; architecture; main threats and system survivability.

It is shown that the very concept of survivability of the TDICS UIS is central to the study of system behavior in abnormal situations caused by negative influences, and ensuring the survivability of such systems is of great importance for their existence and effective operation. The problem of ensuring survivability is especially relevant in special-purpose systems, where the cost of system failure can be too high. Tabl.: 1. Fig.: 5. Refs: 26 titles.

Key words: territorially distributed information computer system, unified information space, organizational management, information processes, structure, subsystem, automated workplace, multi-agent system, critical infrastructure object, destructive influences, threats, survivability.

Mokhor V.V., Korobeynikov F.O. Resilience and stability in security. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 113–120. — Ukr.

The investigation discusses the difference between the concepts of «resilience» and «stability». It is noted that within the Ukrainian national academic scientific dialogue there is a significant terminological uncertainty, due to the lack in the Ukrainian lexical array of historically established equivalent of the English-language term «resilience», which occupies a key place in the modern security paradigm among the English-speaking scientific community. As a result, the Ukrainian-language scientific discourse uses a variety of synonymous terms that distort the semantic load of the original concept of «resilience»

There are analyzed in detail the differences between the concepts of «stability» and «resilience», stressing that despite the fact that both of these concepts cover similar areas, their goals and scope of practical application in the security domain are significantly different.

«Stability» is defined by the author as the resistance of a system to change and the ability to return to its initial state in response to perturbations.

«Resilience» is seen as a more dynamic property, implying the ability of a system to adopt and develop in response to threats and environmental changes. This concept includes not only recovery from perturbations, but also adaptation, the ability to self-organize and evolve in the process of interaction with changing conditions.

The author analyses these concepts through the prism of chaos theory and synergetic, emphasizing that resilience includes elements of non-linearity and the ability to self-organize under conditions far from equilibrium. These concepts help to understand how systems can evolve and adapt, turning random perturbations and crises into opportunities to evolve and improve their functions.

Finally, the author emphasizes the need to distinguish precisely between these concepts in research and practice, especially within the security domain. Fig.: 2. Refs: 14 titles.

Key words: resilience, stability, information security, risk, chaos theory, synergetic.

UDC 004.5

Dodonov O.G., Nikiforov O.V., Putyatin V.G., Dodonov V.O., Kutsenko S.A., Germaniuk A.P., Izvarin I.V., Kravchuk K.O. Technology for ensuring the survivability of territorially distributed information computer systems in a unified information space. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 121–143. — Ukr.

The study discusses the technology of ensuring the structural, functional and informational survivability of territorially distributed information computer systems of arbitrary architecture in a unified information space (TDICS UIS), which is a set of processes, mechanisms, tools, algorithms and mathematical models, the implementation of which ensures the ability of the system to adapt to new conditions functioning, resist threats and adverse influences, preserve or promptly restore the ability to perform the functions of the TDICS UIS with minimal loss of efficiency in the event of degradation or failure of individual components of the system due to the use of available operational resources. The technology is implemented in the form of a special survivability subsystem, which includes the following main modules: monitoring; analysis; localization; making decisions; implementation of the developed solution; agents and internal databases and knowledge. The results of the work can be used to create a method and appropriate methodology for the reconstruction of information structures in systems that have undergone partial destruction, or for the restoration of lost information structures and resources. The developed technology can be used in the construction of TDICS UIS of any purpose. The use of survivability technology will allow TDICS UIS to automatically adapt to new operating conditions and avoid the devastating consequences of destructive influences that can lead to significant losses and consequences. Tabl.: 6. Fig.: 7. Refs: 9 titles.

Key words: threats, destructive influences, unified information space, survivability, information resource, module, territorial-distributed information computer system, technology.

UDC 303.732.4

Kuznietsova N.V., Shevchuk O.S. Green projects risk assessment models. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 1. P. 144–153. — Ukr.

The study is devoted to the analysis and forecasting of green projects investment and credit risks. The peculiarity of such projects is their ecological orientation. The assessment of their risks needs an analysis of both economic and ecological components. The work researches existing approaches, methods and risk assessment models, both for the classic, purely economic case, and as well with environmental component. The existing classic methods of risk assessment are considered and their advantages and disadvantages are noted. Techniques for collecting, analyzing and combining data sets of economic and environmental indicators are proposed. Through modeling on the obtained data, the effectiveness of applying various methods such as: logistic regression, decision trees, random forest, AdaBoost and Extra Trees for risk assessment was shown for the case of economic and environmental data analysis. The simulation results have demonstrated that the application of classical assessment methods taking into account the ecological component is possible and the effectiveness of such forecasting will be sufficiently high. The idea of developing specialized approaches to assessing the green projects risks taking into account a wide range of identified factors is proposed. For investment and lending it will be possible to take into account not only the impact of carbon emissions, but also other types of pollution, which will allow by implementing green projects to improve the environmental situation of the world ecosystem as a whole. Tabl.: 5. Refs: 21 titles.

Key words: green projects, risk assessment, methodology, logistic regression, decision trees.
