Реферати

UDC 539.219.1; 004.08

Rubish V.M., Pop M.M., Petrov V.V., Makar L.I., Kryuchyn A.A., Yasinko T.I., Rubish V.V., Mykaylo O.M., Kaynts D.I., Kostyukevih S.O. Laser-induced changes in optical properties of amorphous films of the system Ge-Se. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 2. P. 3–9. — Ukr.

The influence of laser radiation with λ = 530 and 650 nm on the transmission spectra of amorphous $GeSe_x$ films was studied. The calculated values of pseudo forbidden gap E_g and refractive index n of films. Two types of photo-induced effects in the films have been identified — photobrightening ($GeSe_5$, $GeSe_3$, $GeSe_2$) and photodarkening ($GeSe_{15}$, Ge_2Se_3). At photodarkening of the films their E_g decreases and n increases also. It was established that the level of changes in the optical parameters of $GeSe_5$ and $GeSe_{15}$ films upon their laser irradiation is much higher than that of films of other compositions ($GeSe_8$, $GeSe_4$, $GeSe_3$, $GeSe_2$, Ge_2Se_3).

For the $GeSe_8$ film, oscillations were detected in the dependences of E_g and n on their exposure time (λ = 530 nm). At short exposure times (up to 1 min.), photodarkening of films takes place. As the exposure time increases, the $GeSe_8$ film brightens. However, the level of changes in the optical parameters of the film of the specified composition is very low. When the $GeSe_8$ film is exposed to red laser radiation, the transmission spectra shift to the short-wavelength part of the spectrum (brightening of film). For films of other compositions, the spectra shift weakly into the long-wavelength region. For $GeSe_4$ and $GeSe_3$ films, oscillations (photodarkening — photobrightening) were detected on the dependences of E_g and n on the exposure time. Some differences in the results of studies of the films when they are irradiated with green and red lasers are associated with a photoplastic effect, which appears in them when illuminated by light from the region of the edge of its own absorption. Tabl.: 2. Fig.: 4. Refs: 17 titles.

Key words: amorphous films, optical characteristics and parameters, photo-induced effects.

UDC 004.94+515.4

Zalevska O.V., Pukha G.S., Varava I.A., Koval O.V., Pirogovska T.V., Musienko A.P. Chebyshev coefficients in modeling the wave process by the method of normal modes. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 2. P. 10–18. — Ukr.

A method of taking into account the time parameter in the three-dimensional method of normal modes, which is used in the development of software for modeling the propagation of the hydro-acoustic field, is considered. A transition from classical time accounting to discrete and vice versa is proposed. The introduction of the time coordinate expands the possibilities of research and modeling of wave equations. In a dynamic emitter-receiver system, the weight of influence on the system of each mode is different. The influence of a normal wave on the system during a certain period of time is provided by Chebyshov's polynomial coefficients.

During the statistical analysis of the obtained data, data interpolation was considered using linear, exponential, quadratic and logarithmic functions. It was established that quadratic and exponential functions have the same values of model adequacy parameters and approximation accuracy. In the future, it is proposed to approximate the resulting series with a quadratic function, which reduces calculations and the load on computing equipment.

The hydro-acoustic field simulation software complex was used for modeling. The software complex consists of 5 packages: HydroAcModComp, HydroAcModCompViewModels, ModCompGeoFunction, SQLData, NormalModes. The implementation of simulation calculations by the method of normal modes is carried out in the NormalModes package.

A computer simulation was carried out using hydro-acoustic field simulation software, the results of which obtained dependencies allow entering a time parameter into the solution of the wave equation by the method of normal waves. This provides the possibility of predicting the development of the sound wave over time and does not require additional studies of the time variable. Tabl.: 1. Fig.: 5. Refs: 12 titles.

Key words: Method of normal modes, time variable, hydro-acoustics, hydro-acoustic signals, sound wave modeling software, information technologies.

UDC 004.05

Lande D.V., Rybak O.O. Semantic Indexing and Cluster Analysis of Cybersecurity Documents. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 2. P. 19–32. — Ukr.

This study examines methods for extracting concepts from textual messages and constructing semantic networks for text data analysis, specifically within the context of cyberthreats. The semantic networks are essential tools for identifying key concepts and their relationships which provide a better

understanding of the relationships between concepts and help uncover critical data such as hacker group names, malicious programs, vulnerabilities, and other threats. Such an approach can be applied in cybersecurity, where textual information can contain vital data for preventing and responding to cyber threats.

The focus is on the use of large language models (LLMs) that enable automated extraction of entities and the construction of concept networks. Utilizing LLMs for information extraction from text data helps create networks of relationships that can be used to analyze causal links between events and objects, detect interdependencies, and structure information. These networks can be further employed for cluster analysis, allowing for the automatic grouping of nodes by similarity and the identification of new patterns in the data.

The research also addresses the construction of document proximity networks, which assess the degree of similarity between texts based on their semantic structures. This enables the identification of thematically related documents that may contain significant information for analysis, as well as the detection of informational chains and key trends within large textual datasets.

By applying the methods described in the article, it is possible to effectively structure and analyze large volumes of textual information in cybersecurity, facilitating quicker threat detection and the formulation of strategies for prevention. This approach also allows for the streamline of many stages of analytical work to do, thereby enhancing the efficiency of big data analysis. Fig.: 3. Refs: 11 titles.

Key words: Semantic Indexing, Cluster Analysis, Modularity, Large Language Models (LLMs), Cybersecurity, Text Analysis, Semantic Networks.

УДК 004.032.26

Оцінка ефективності застосування сервісів «ChatGPT» та «Google» для наукового пошуку. *Реєстрація, зберігання і оброб. даних*. 2024. Т. 26, № 2. С. 33–43. — англ.

Проведено порівняльний аналіз ефективності застосування онлайн-сервісу «ChatGPT», що базується на великій мовній моделі та механізмах адаптації для ведення діалогів природними мовами, а також пошукової системи «Google Search Engine». Цільовими показниками порівняльного аналізу слугували швидкодія, точність і користувацький досвід при пошуку інформації у рамках проведення наукового дослідження. На основі наборів даних, що представляють результати виконання зазначеними онлайн-сервісом і пошуковою системою серії запитів було досліджено продуктивність роботи в режимі діалогової взаємодії. За тестові завдання було обрано завдання аналізу азіатського ринку світлодіодів і сучасного стану досліджень технологій, що базуються на використанні джерел ближнього інфрачервоного випромінювання. Проведено порівняння за цільовими показниками, що представлені на кількісному рівні, зокрема, за часом обробки вхідного запиту, відповідністю результатів виконання поставленому запиту, а також індивідуальним досвідом користувачів. Це надало можливість виділити сильні та слабкі сторони онлайн-сервісу «ChatGPT» і пошукової системи «Google Search Engine», а також сформувати методологічні рекомендації щодо їхнього використання в науковому пошуку. Зазначено, що онлайн-сервіс «ChatGPT» ефективно виконує запити, які сформовано за принципами природної мови, як таку в рамках дослідження було обрано англійську. Індивідуальний досвід користувачів вказує на високий рівень персоналізованої взаємодії при роботі з «ChatGPT», що сприяє ефективності роботи при роботі над науковим проектом на етапах наукового пошуку, аналізу даних і підготовки результатів наукового дослідження. Було вказано на значні переваги у використанні механізму «ChatGPT 4.0» над «ChatGPT 3.5» за об’ємом, релевантністю та структурованістю відповіді. Натомість, пошукова система «Google Search Engine» характеризується високими показниками точності, актуальності та об’єму наукових даних, але робота із зазначеним онлайн-сервісом при цьому потребує від дослідника відповідної кваліфікації. Табл.: 4. Іл.: 3. Бібліогр.: 16 найм.

Ключові слова: велика мовна модель, метакогнітивне саморегульоване навчання, пошукова система, ChatGPT, сервіси Google, час затримки, аналіз запиту.

UDC 004.5

Khomenko A.M., Senchenko V.R., Koval O.V. A network approach in the study of cascading effects critical infrastructures. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 2. P. 44–72. — Ukr.

A cascading failure of critical infrastructure can lead to serious consequences in various areas of human activity, so it is important to detect and take preventive measures in time to reduce the consequences of the cascade. The article presents an analysis of the capabilities of the network approach in building and researching a cascade model based on graph theory. This provides an understanding of the complex interdependencies that exist in real systems. With the help of metrics that determine the quality of the graph model, it is possible to determine the centrality and importance of the nodes of the model, to evaluate the

characteristics of objects, to calculate the probabilities of transitions and the occurrence of critical events, to study different scenarios of the development of the cascade and the consequences of the impact. Electric power industry is considered as a field of application. The use of graph theory and network analysis allows us to present the energy network as a complex interconnected network of nodes and finite constraints, which have semantic content in the form of: power line, transformer substation, impedance, etc. The study considers the application of various network approaches - Bayesian network, Petri network, Markov chain and presents the results of a comparative analysis of their capabilities in the study of the behavior of systems during a cascade. The analysis of these methods with reference to the fields of application allows to more perfectly adapt these methods to specific needs, as well as to form requirements for software tools for modeling and monitoring the negative consequences of cascading effects. Tabl.: 1. Fig.: 9. Refs: 51 titles.

Key words: critical infrastructure, cascade failure, Domino effect, graph theory, Bayesian network, Petri net, Markov chain, ontology.

UDC 617.751

Zenin V.N., Antonov E.E. Peculiarities of calculating the geometric parameters of a diamond cutter for the formation of ring Fresnel lenses. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 2. P. 73–80. — Ukr.

An algorithm has been developed for calculating the angles of mutual location and inclination of the cutting part of the diamond tool under the production of microprism ring plastic lenses and the corresponding metal matrices by the method of blade microcutting. When using a diamond tool and special precision equipment, this method allows one to obtain high accuracy of the geometric parameters of the microstructure of the lens and high purity of the processed working refracting surfaces, which in turn leads to the high quality of the image in the lens focus. Working formulas are given for calculating the angles of inclination of the cutting face of the cutter relative to the front face and to the central axis of the cutter depending on the angle at its apex.

The working refracting surface of the lens groove is inclined at certain angle to the plane of the lens, the second non-working groove surface is perpendicular to this plane. These specified surfaces are formed with a specially made diamond cutter, which is a metal rod with a fixed diamond. The front working face of the diamond is located at the necessary angle to the central axis of the cutter. This angle is usually set to ~24 degrees, based on the technological considerations. The angle at the tip of the cutter should be smaller than the additional angle of the lens groove with the minimum value of microprism refractive angle. During the microcutting process these cutter's angles should be settled so, that in the process of turning the lens it is not allowed to touch the rear parts of the cutter to the vertical non-working surfaces of the groove. If this requirement is not met, it is necessary to correct the geometry of the cutter. A calculation algorithm is proposed and the range of critical parameters of the lens is defined, under which the above damage of the forming refractive surfaces of the lens cannot be fixed during the lenses and matrixes manufacture. Tabl.: 2. Fig.: 6. Refs: 5 titles.

Key words: geometric parameters of the cutter, ring focusing structures, microprismatic lenses.

UDC 004.08; 004.023; 004.085

Ivanytsky V.P., Rubish V.M., Tarnay A.A., Chichura I.I., Rubish V.V., Dalekorey A.V., Meshko R.O., Ryaboshchuk M.M., Tsygyca V.V. Automation of measurements of the rate of thin films chemical etching. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 2. P. 81–91. — Ukr.

The peculiarities of the interference method application for the processes of controlling the thin films thickness and measuring their etching rate are analyzed. The possibilities of complete automation of such processes during chemical etching of various types of substances have been investigated. In the course of research, an optical structural diagram of the interference method was developed, which is optimal for automatic measurement of the thin films etching rate. This optical scheme is implemented with normal incidence of optical probing radiation on the test sample in the form of a substrate with a thin film. It is recommended to use optical fibers as elements of the entire optical path of the scheme. Within the framework of the proposed optical scheme, changes in the interference pattern on As_2S_3 thin films during their chemical etching in an aqueous solution of sodium carbonate were experimentally investigated. The behavior of the intensity of interference during the etching process indicates the prospects of using the interference method to create automatic devices for measuring the speed and dynamics of thin film etching in real time. The estimated absolute error of automatic etching rate measurements does not exceed ±0,5 nm/s. A limitation of the researched method was noted — the presence of a transparency window in some optical spectral range in the studied samples. The proposed approaches are suitable for designing devices for

automatic control of chemical etching processes of various substances and for creating algorithms for the functioning of such devices. Tabl.: 1. Fig.: 3. Refs: 9 titles.

Key words: automation of chemical etching processes, chalcogenide amorphous films, photoresists, interference methods of thickness control.

UDC 550.34.01

Britsky O.I., Tokalin O.O. Spread of the correlation detection method of movement for heavy objects using seismometers — velocimeters. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 2. P. 92–96. — Ukr.

The results of research on the identification both natural and man-made seismic events using digital laser seismometers are presented. The study is aimed at identifying seismic events by using precision laser seismometers and methods of correlation analysis. However, the most widespread in seismology devices are velocimeters, which measure the rate of oscillation of the Earth's surface. For examples they can be seismometers STS 2, Guralp CMG-T40, various molecular-electronic, geophones and others. Therefore, the task of spreading the developed method of correlation detection of the movement of heavy objects when using velocimeters is urgent. The research presents an analytical approach for identifying relationships between the cross-correlation functions of seismic processes obtained by measuring displacements and velocities. Such a connection has been confirmed experimentally. At the same time, the same seismic process, registered during 4 hours, was studied. Various seismic portraits of the movement of heavy objects were used. In the given example, the time difference between the recording of the seismic portrait and the process itself was about 4 years. The rates of seismic processes were interpreted by their first differences. Seismic portraits and seismic processes were interpreted separately. The sampling rate was 100 Hz. A sampling rate of 2 kHz was used for the analysis of faster processes. Minor differences in the obtained results are explained by the increased influence of noise interference when measuring the speed. Fig.: 2. Refs: 6 titles.

Key words: movement of heavy equipment, digital laser seismometers, velocimeters, seismic portraits of speed and the processes themselves, cross-correlation analysis.

UDC 004.5

Boychenko A.V. Application of the visual analytics in support of military decision making. *Data Rec., Storage & Processing*. 2024. Vol. 26, No. 2. P. 97–106. — Ukr.

Visualization is widely used to support tasks in the process of decision support and predictive analytics. The main usage covers data cleaning, research analysis and diagnostics. Military maps are the most important tools for analyzing the situation and supporting decision-making at all levels. Incorporating geospatial and temporal data is critical for sophisticated data visualization and analysis in military information systems. Iintegration of geospatial data (latitude, longitude and altitude), as well as temporal data covering time and duration of operations, improves situational awareness. This study examines features of information visualization technologies and visual analytics for decision-making in the military sphere. It has been carried out an expert assessment procedure for tools compliance into given requirements and establish pairwise comparisons matrices. Using of visualization and visual analytics tools allows increase management military decisions effectiveness accelerating analysis of large dimensions of information and simultaneous indicators and scenarios review. The work has demonstrated the key requirements to implementation of information's visualization and visual analytics tools in military management decision support systems. Issues of using information visualization and visual analytics tools are active area for exploration in Institute for Information Recording of the National Academy of Sciences of Ukraine Modeling complex. The results will become a segment of Managing forces and means Armed Forces automated system, that will integrate management elements of strategic, operational and tactical levels into a single information-functional capacity. Choice of specific means and methods, in particular, geospatial data standards and modeling tools, will be based on how well they satisfy the established requirements. Tabl.: 5. Fig.: 4. Refs: 15 titles.

Key words: analytical activity, management decision support systems, information visualization, visual analytics.