о распространении сейсмических и акусто-гравитационных волн для совмещённой модели "Земля–Атмосфера " при наличии ветра в атмосфере. Созданы параллельные программные комплексы, которые позволили провести расчеты и исследовать особенности распространения и взаимогенерации сейсмических и акусто-гравитационных волн на границе раздела упругой среды и атмосферы, а также влияние ветра в атмосфере на их распространение. Разработан пошаговый метод Лагерра для решения динамических задач теории упругости. Выполнено обоснование выбора необходимых параметров расчета для проведения устойчивых вычислений.

В рамках спектрально-разностного подхода предложены численные процедуры для решения динамической задачи теории упругости в случае криволинейной свободной поверхности. На основе аналитического метода создана компьютерная программа, позволяющая проводить моделирование волновых полей для значительных пространственно-временных масштабов, характерных для современных экспериментальных данных, в частности, вибросейсмических. Построена теория и созданы алгоритмы регуляризации и численного решения задачи продолжения геофизических полей с поверхности Земли в сторону залегания неоднородностей. Исследована теоретическая и практическая устойчивость.

Результаты применены для электромагнитного зондирования дорожных покрытий, исследования древних захоронений, диагностики состояния селезащитной плотины в ущелье Медео (Алматы, Казахстан). Разработаны новые алгоритмы определения амплитуды волны цунами в приближении мелкой воды, при реализации которых вместо традиционных трехмерных задач решается двумерная задача. Получено уравнение для двумерной амплитуды, которое в одномерном случае совпадает с известной формулой Эйри-Грина. Доказаны теоремы единственности и получены оценки устойчивости решения обратных задач для системы интегро-дифференциальных уравнений электродинамики с учетом дисперсии волн, для вязко-упругих, магнито-упругих и пористых сред. Исследованы групповые свойства системы уравнений Максвелла, уравнения эйконала. Получены новые законы сохранения. Разработаны математические модели тороидальных и полоидальных электромагнитных полей. Разработана методика определения низкочастотной составляющей статических поправок по годографам времен первых вступлений рефрагированных волн. Построены алгоритмы численного моделирования для высокочастотного акустического зондирования дна водоемов. Создана информационно-экспертная система "Цунами" (ИЭСЦ). Изучено влияние батеметрии на параметры волн цунами при их распространении над неровным дном. Создана сейсмотектоническая схема очагов цунамигенных землятрясений в Дальневосточном регионе РФ.

METHODS AND INTERACTIVE TOOLS OF THE SYSTEM GEOBAZADANNYCH FOR ADAPTATION OF DIGITAL FIELDS FOR COMPUTER MODELS. COMPONENTS OF THE SYSTEM

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Geological modeling is an independent direction that includes the improvement of mathematical methods and algorithms; development of computer programs that provide a cycle of model construction, forming, filling and maintenance of databases [1], [2]. The corresponding software includes the loading from different sources and data preprocessing, correlation, creation of digital cubes of reservoir properties, interactive data analysis, visualization with the help of any type graphics, mapping. The task of developing and implementing various computer-based geological models with self-tuning tools is one of the priorities. Herewith, an important component is the task of evaluating the adequacy and accuracy of the proposed digital models.

The key issues are automation, adaptation of models taking into account continuously incoming additional data, as well as a revision of the results of processing the initial information using new interpretation methods [2], [3].

The data used in geological and geoecological models are a representative part of the geodata, which classify, summarize information about processes and phenomena on the earth's surface, include classified and integrated into a single system of data groups. Geodata, as a generalization of accumulated information [4], include information not only from the field of Earth sciences, but also from others, such as transport, economics, ecology, management, education, analysis, artificial intelligence. The technological feature of geodata is that they are not obtained on the basis of direct measurements, and they are formed as a result of post-processing of the measured information, can have different accuracy, stored using different units of measurement. The system peculiarity is that after their formation geodata represent a set of parameters and descriptions of different types and structures integrated into a single complex, reflect different characteristics and properties, describe the existing spatial relations taking into account time and thematic factors. Information feature is due to the fact that geodata is a new information resource, and the data are grouped into three characteristics: place, time, topic. Another feature is the presence (implemented automatically) of mutual influence of graphic and attribute data – changing attribute data involves the replacement of graphic information, the refinement of the spatial position requires changes in coordinates, spatial relationships. This interaction provides a reliable foundation for spatial visual analysis and management.

Geodata volumes are growing at a very high rate. Accordingly, it is natural to use "big data" technologies (the specifics for geodata are described in [5]), including automated data mining. One of the main aims of data mining is to find previously unknown, non-trivial, practically useful and understandable interpretations of knowledge in "raw" (primary) data sets [6], [7]. At the same time, following [6], "data mining does not exclude human participation in processing and analysis, but significantly simplifies the process of finding the necessary data from raw data, making it available to a wide range of analysts who are not specialists in statistics, mathematics or programming. Human participation is expressed in the cognitive aspects of participation and the application of informational cognitive models".

Geodata mining tools are the same as for usual data; the basis is the theory, methods, and algorithms of applied statistics, databases, artificial intelligence, and image recognition. There are many different active and applied software tools for data mining, for example, 8 classes of data mining systems are identified in [6]. The variety of proposed methods and software tools make it necessary to assess the quality of geodata and determine their main characteristics. Criteria for evaluating the quality of geodata are discussed in [8].

A number of issues related to the analysis and evaluation of spatial data quality can be solved using the computer system GeoBazaDannych [9] – [16]. Possible options, methodological solutions, and software tools that allow you to confirm the validity of interpretations, visualize and obtain numerical values of errors calculated by different methods of intellectual data processing results included and used in computer geological models are discussed below. For illustrations, the key task of forming and processing digital fields used in computer models is selected. In particular, we discuss the proposed methods that have been tested for solving different applied problems, as well as implemented in the interactive computer system GeoBazaDannych specialized algorithms for calculating approximating digital fields.

The interactive computer system GeoBazaDannych is the complex of intelligent computer subsystems, mathematical, algorithmic and software for filling, maintaining and visualizing databases, input data for simulation and mathematical models, tools for conducting computational experiments, algorithmic tools and software for creating continuously updated computer models. By means of the system GeoBazaDannych, it is possible to generate and visualize digital descriptions of spatial distributions of data on sources of contamination, on the geological structure of the studied objects; graphically illustrate solutions to problems describing the dynamic processes of multiphase filtration, fluid migration, heat transfer, moisture, and

mineral water-soluble compounds in rock strata; design and implement interactive scenarios for visualization and processing the results of computational experiments. GeoBazaDannych's subsystems allow you to calculate and perform expert assessments of local and integral characteristics of ecosystems in different approximations, calculate distributions of concentrations and mass balances of pollutants; create permanent models of oil production facilities; generate and display thematic maps on hard copies.

The main components of the system GeoBazaDannych [9] – [16]:

- the data generator Gen_DATv;
- the generator and editor of thematic maps and digital fields Gen_MAPw;
- modules for organizing the operation of geographic information systems in interactive or batch modes;
- the software package Geo_mdl – mathematical, algorithmic and software tools for building geological models of soil layers, multi-layer reservoirs; modules for three-dimensional visualization of dynamic processes of distribution of water-soluble pollutants in active soil layers;
- software and algorithmic support for the formation and maintenance of permanent hydrodynamic models of multiphase filtration in porous, fractured media;
- the integrated software complex of the composer of digital geological and geoecological models (GGMD).

Basics and tools of interactive adaptation of digital fields. Integration of the capabilities of various geographic information systems (GIS) and the GeoBazaDannych is provided by a wide range of tools of the system for importing and exporting data, images, and functions. This article discusses several non-standard solutions that are recognized as difficult for all geodata processing packages. The examples of approximation and reconstruction of the digital field presented in the second part of the work, its interactive adaptation by means of the system GeoBazaDannych and evaluation of the accuracy of results using the tools of the GGMD complex illustrate the unique capabilities of the developed methods and software.

The task of reconstruction of the grid function (digital field) involves calculating the values of the approximating function at regular grid points from the values of randomly located experimental data points (observations), i.e. creating a regular array of Z values of node points from an irregular array of (X,Y,Z) values. The term “irregular array of values” means that the X, Y coordinates of data points are distributed irregularly across the function definition area. The procedure for constructing a regular network of level values and restoring the grid function is an interpolation or extrapolation of values from a collection of scattered sets of source points and values of surface levels in them to uniformly distributed nodes in the study area.

Methods for restoring grid functions and the corresponding algorithms are implemented in several specialized computer graphics and GIS packages. They can be divided into two classes: exact and smoothing interpolators [17], [18]. In fact, the method falls into a particular class depending on the user-defined settings when performing value calculations. Most methods for restoring the function and constructing a digital field are based on calculating weighted coefficients that are used to weigh the values of the measurement data at the nearest points. This means that, all other things being equal, the closer the data point is to a network node, the more weight it has in determining the value of the function being restored at that node.

It should be understood that restoring a grid function does not imply finding a single solution to a certain mathematical problem. Subjective opinion and expert qualifications are factors that are always present in such activities [19]. To create computer models, you need to have tools for interactive data processing and implementation of possible situations of receiving and correcting input information, modules for mathematical processing, interpretation and statistical analysis [11], [17], [20], [21]. For the compiler of any computer model, it is important to be able to perform data analysis using different methods and algorithms in several software environments, to have tools that allow him to “play” with the source data and compare the results with the prepared reference models. This assumes that there are tools for exchanging data

between modules that use different formats. How these requirements are implemented in the system GeoBazaDannych is described below.

The examples of approximation and reconstruction of the digital field, its interactive adaptation by means of the system GeoBazaDannych and evaluation of the accuracy of results using the GGMD complex illustrate the unique capabilities of the developed methods and software. Using the tools of the GGMD complex ([14] – [16], [21]), estimates of the accuracy of digital field reconstruction are obtained and illustrated with graphics.

Conclusion. The article presents the features of the processed data and the corresponding set of software tools of the interactive computer system GeoBazaDannych.

Bibliography

1. Bedrikovetsky, P: Mathematical Theory of Oil and Gas Recovery: With Applications to ex-USSR Oil and Gas. Springer Science & Business Media. – 2013. – 575 p.
2. Dmitrievskii, A.N. Bol'shie geodannye v cifrovoi neftegazovoi ekosisteme / A.N. Dmitrievskii, N.A. Eremin // Energeticheskaya politika. – 2018. – № 2. – P. 31–39, (in Russian).
3. 13th International Symposium on Software Engineering for Adaptive and Self-Managing Systems. Gothenburg, Sweden, May 28-29, 2018. Available at: https://conf.researchr.org/track/seams-2018/seams-2018-papers (accessed 2020, Oct).
4. Savinyh, V.P. Geodannye kak sistemnyi informacionnyi resurs / V.P. Savinyh, V.Ya. Cvetkov // Vestnik Rossiiskoi akademii nauk. – 2014. – V. 84, № 9. – P. 826–829, (in Russian).
5. Tsvetkov, V.Ya. Big Data as Information Barrier / V.Ya. Tsvetkov, A.A. Lobanov // European Researcher. – 2014. – V. 78, № 7–1. – P. 1237–1242.
6. Shaitura, S.V. Intellektual'nyi analiz dannyh geodannyh / S.V. Shaitura // Perspektivy nauki i obrazovaniya. – 2015. – № 6 (18). – P. 24–30, (in Russian).
7. Taranchuk, V.B. Intellektual'nye vychisleniya, analiz, vizualizaciya bol'shih dannyh / V.B. Taranchuk // BIG DATA and Advanced Analytics : sb. materialov V Mejdunar. nauch.-prakt. konf. Respublika Belarus', Minsk, 13–14 marta 2019 goda). V 2 ch. Ch. 1. – Minsk : BGUIR. – 2019. – C. 337–346, (in Russian).
8. Dyshlenko, S.G. Analiz i razrabotka harakteristik kachestva geodannyh / S.G. Dyshlenko // Perspektivy nauki i obrazovaniya. – 2016. № 2 (20). – P. – 23–27, (in Russian).
9. Taranchuk, V.B. Chislennoe modelirovanie processov dvuhfaznoi mnogokomponentnoi fil'tracii v neodnorodnoi poristoi srede. Doktorskaya dissertaciya, Kazan' State University (1992), (in Russian)
10. Barvenov, S.A. Metodika, instrumentarii adaptacii matematicheskih modelei processov podzemnoi gidrodinamiki / S.A. Barvenov, M.F Kibash, V.B. Taranchuk // Vybranyya navukovyya pracy BDU, t. "Matematika", – Minsk, 2001. – P. 34–65, (in Russian).
11. Taranchuk, V.B. Postroenie cifrovyh geologo-ekologicheskih modelei v sisteme GBD-e / V.B. Taranchuk // Geoekologiya Belarusi / – Minsk : Pravo i ekonomika, Nauchnoe izdanie, 2006. – P. 72–96, (in Russian).
12. Lishtvan, I.I. Modelirovanie i graficheskaya vizualizaciya rasprostraneniya vodorastvorimyh zagryaznyayuschih veschestv v deyatel'nom sloe pochvogruntov / I.I. Lishtvan, G.P. Brovka, V.B. Taranchuk // Prirodnye resursy. – 2004. – № 1, – P. 124–126, (in Russian).
13. Taranchuk, V.B. Interaktivnaya komp'yuternaya sistema vizualizacii processov perenosa primesei v pochvogruntah "GBD-p" / V.B. Taranchuk, V.V. Taranchuk // Prirodopol'zovanie. Sb. nauchn. tr. Vyp. 11. Institut problem ispol'zovaniya prirodnyh resursov i ekologii NAN Belarusi. – Mn. : ODO "Tonpik", – 2005. – P. 139–143, (in Russian).
14. Taranchuk, V.B. The integrated computer complex of an estimation and adapting of digital geological models / V.B. Taranchuk // Studia i Materiały. – 2017. – №. 2 (14). – P. 73–86.
15. Taranchuk, V.B. Programmnyi kompleks adaptacii geologicheskih modelei. Koncepciya, resheniya, primery realizacii / V.B. Taranchuk // Problemy fiziki, matematiki i tehniki. – 2017. – № 3 (32). – P. 81–90, (in Russian).

16. Taranchuk, V.B. Metody i instrumentarii ocenki tochnosti komp'yuternyh geologicheskih modelei / V.B. Taranchuk // Vestnik BrGTU. – 2018. – № 2. – P. 64–69, (in Russian).

17. Davis, J.C. Statistics and data analysis in geology. New York : John Wiley & Sons Inc. –2002, – 656 p.

18. Sacks, J. Design and Analysis of Computer Experiments / J. Sacks, W.J. Welch, T.J. Mitchell, H.P. Wynn // Statistical Science. – 1989. V. 4, № 4. – P. 409–435.

19. Halimov, E.M. Detal'nye geologicheskie modeli i trehmernoe modelirovanie / E.M. Halimov // Neftegazovaya geologiya. Teoriya i praktika. – 2012. – № 3(7). – P. 1–10, (in Russian).

20. Taranchuk, V.B. New computer technologies, analysis and interpretation of geodata / Valery Taranchuk // MATEC Web of Conferences IPICSE-2018. – V. 251, 04059. VI International Scientific Conference "Integration, Partnership and Innovation in Construction Science and Education" (IPICSE-2018). – P. 1–8. doi.org/10.1051/matecconf/20182510405.

21. Taranchuk, V.B. Examples of the use of artificial neural networks in the analysis of geodata / Valery B. Taranchuk // Open Semantic Technologies for Intelligent Systems : Research Papers Collection. – 2019. – Issue 3. – P. 225–230.

ЎЗБЕКИСТОН РЕСПУБЛИКАСИ ИҚТИСОДИЁТИНИ РАҚАМЛАШТИРИШДА АХБОРОТ ХАВФСИЗЛИГИНИ ТАЪМИНЛАШ МУАММОСИ

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Аннотация: *мазкур мақола Ўзбекистон Республикаси иқтисодиётини рақамлаштиришда ахборот хавфсизлигини таъминлаш муаммосига бағишланган бўлиб, ушбу соха бўйича таъминлашнинг хозирги холати, даражалари, қўлланиладиган технологиялар, асосий йўналишлари, тахдидлар ва ўтказилиши зарур бўлган чора-тадбирлар хақида фикр юритилган.*

Калит иборалар: *рақамли иқтисодиёт, ахборот технологиялари, ахборот ҳавфсизлиги, рақамлаштириш даражалари, қўлланиладиган технологиялар, асосий йўналишлари, тахдидлар.*

Хурматли Баходир Аллабердиевич, хурматли модераторлар, конференция иштирокчилари!

Барчамизга маълумки, Президентимиз Шавкат Мирзиёев ташаббуси билан жорий йил Илм-маърифат ва рақамли иқтисодиётни ривожлантириш йили деб номланди.

Юртимиз «Халқаро ахборот-коммуникация технологияларини ривожлантириш индекси» бўйича 2019 йилда 8 поғонага кўтарилган бўлса-да, ҳали жудаям орқадамиз. Шу боис, «Рақамли иқтисодиёт»га фаол ўтиш – келгуси 5 йилдаги энг устувор вазифаларимиздан бири бўлади. Рақамли технологиялар нафақат маҳсулот ва хизматлар сифатини оширади, ортиқча харажатларни камайтиради. Шу билан бирга, энг оғир иллат – коррупция балосини йўқотишда ҳам самарали воситадир, деб таъкидлади юртбошимиз.

Икки ой муддат ичида «Рақамли Ўзбекистон-2030» дастури ишлаб чиқилиши режалаштирилди ва амалга оширилди. Ишларни тизимли ташкил этиш учун ҳукуматда бош вазир ўринбосари, вазирлик ва идораларда ҳамда ҳокимликларда алоҳида ўринбосар лавозимлари жорий этилди. Короновирус пандемияси рақамлаштириш жараёнини янада долзарблаштирди ва тезлаштирди.

Бугунги «Математик моделлаштириш, ҳисоблаш математикаси ва дастурий таъминот инженериясининг долзарб муаммолари» мавзусидаги республика миқёсида

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