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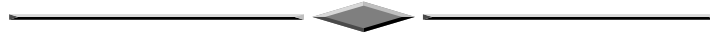
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# GEODESY AND MINE SURVEY



## ABOUT CHANGE OF COORDINATES IN TERRITORY OF THE RUSSIAN FEDERATION AT TRANSITION FROM CS-95 TO SSC-2011

*Vladimir I. Obidenko*

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Vice-Rector for Educational Activities, phone: (383)343-39-88, e-mail: ovi62@yandex.ru

Results of researches are resulted according to character and sizes of changes of co-ordinates on territory of the Russian Federation at transition from the state system of co-ordinates CS-95 to state system of co-ordinates of SSC-2011. It is noticed that in SSC-2011 the problem put by the decision of the United Nations before world geodetic community and consisting in necessity of the co-ordinated approach in creation national and global co-ordinate of bases is optimum solved. SSC-2011 by the principles of construction it is identical to the International Terrestrial Reference System (ITRS), and it spheroid on parametres practically coincides with applied in ITRF2008 spheroids. As a result of researches sizes of changes of geodetic and flat rectangular co-ordinates for 80 000 points in regular intervals located within borders of the Russian Federation on which basis the thematic cards adumbrating about change of widths, longitudes, abscisses and ordinates on territory of the Russian Federation are constructed are received. The table of the maximum, minimum and average values of a difference of abscisses and ordinates for each of 29 Russian Federations covering territory of 6-degree co-ordinate zones (from №4 to №32) in SSC-2011 and CS-95, and also 2 thematic cards classifying these changes in some intervals is resulted. The given table, and also thematic cards of differences of abscisses and ordinates allow manually, without resorting to the help special softs for co-ordinate transformations, to calculate flat rectangular co-ordinates of a point in SSC-2011 on its flat rectangular co-ordinates in CS-95 with accuracy of 1 m.

**Key words:** geodetic system of coordinates of 2011 (SSC-2011), system of co-ordinates of 1995 (CS-95), transformation of coordinates from CS-95 in SSC-2011, change of co-ordinates at transition from CS-95 to SSC-2011.

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## THE METHOD OF LEAST SQUARES (STATICS, DYNAMICS, AND MODELS WITH UPDATED STRUCTURE)

**Boris T. Mazurov**

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Dr. Sc., Professor, Department of Physical Geodesy and Remote Sensing, phone: (383)343-29-11, e-mail: [btmazurov@mail.ru](mailto:btmazurov@mail.ru)

**Vladimir A. Padve**

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Associate Professor, Department of Applied Information Science and Systems, phone: (383)343-18-53, e-mail: [evdapav@mail.ru](mailto:evdapav@mail.ru)

The authors discuss the origin and the technology of the least squares method (LSM) as a solution to the problem of compensating random errors of observations in astronomy and geodesy. The evolution of the LSM functionality from the sum of the squares of the imposed LSM corrections  $[\tilde{v}\tilde{v}] = \min$  to the quadratic form  $\Psi = \tilde{V}_{1n}^T K_{nn}^{-1} \tilde{V}_{n1} = \min$  is described, considering the anticipated correlation of data and different degrees of their precision. The use of LS-adjustment is highlighted by analyzing and interpreting data in dynamic systems with known structure. The authors address the issue of the limitations of using the LSM-based technologies, in situations with unknown structure of the object under study.

**Key words:** least squares method, LS-corrections, functionality, random errors of observations, structure.

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## INVESTIGATION OF THE ACCURACY OF MARKS INTERPOLATION OF THE RAILWAY LONGITUDINAL PROFILE BY DIFFERENT METHODS

**Nikolay V. Kanashin**

Emperor Alexander I St. Petersburg State Transport University, 190031, Russia, Saint Petersburg, 9 Moskovsky Pr., Ph. D., Associate Professor, phone: (812)457-85-38, e-mail: nikolay\_kanashin@mail.ru

**Ivan I. Sukharev**

Emperor Alexander I St. Petersburg State Transport University, 190031, Russia, Saint Petersburg, 9 Moskovsky Pr., Senior Laboratory Assistant, phone: (812)457-85-38, e-mail: sukharev\_ivann@mail.ru

The article contents the results of studies evaluating the accuracy of interpolation of the railway profile elevation by different methods. It is shown that the existing methods of solving this problem are understudied and contains drawbacks. It is assumed that the interpolation is more accurate description of the longitudinal profile than the approximation, and the interpolation method which provides the required accuracy does not depend of the profile type. The correctness of these assumptions was confirmed by experimental calculations and it is found that the best result of interpolation of the elevations of the longitudinal profile of the railway is provided by spline interpolation.

**Key words:** railway, longitudinal profile, interpolation, approximation, accuracy of interpolation, spline interpolation, interpolation of marks.

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## THE SUBSTANTIATION OF METHODS OF ASSESSING THE QUALITY OF BUILDING DIGITAL ELEVATION MODELS

*Alina A. Kochneva*

Saint-Petersburg Mining University, 199106, Russia, Saint-Petersburg, 21 Line V. O., 2, Assistant, Department of Informatics and Computer Technology, phone: (911)73-100-74, e-mail: alinakochneva@mail.ru

The method of construction of digital elevation models according to the airborne laser scanning. The dependence of laser reflection density points from the angles of inclination of the terrain, which is a flat terrain at angles of up to 2 °; hilly terrain with slope angles up to 4 °; rugged terrain with slope angles up to 6 °; Mountain and foothill terrain with slope angles of more than 6 °. Revealed a minimal amount of laser reflection points, which is necessary in the construction of digital elevation models for different typical terrain. In the work of GIS - modeling of the terrain along the route of the road design. In this terrain modeling was carried out in two stages: the first stage of modeling - the creation of a digital terrain model, which includes all the points belonging to the surface. This DTM has been conditionally accepted for the "ideal" model. With her comparing digital elevation models with lower density TLO. The second stage of modeling - the creation of a digital model of the relief on the marks obtained by taking into account the rating of the laser scanner error (m = 0.1 m). areas have been identified to assess the quality of data airborne laser scanning: man-

made nature of the relief; sites located in areas with the greatest inclination angles, such as hilly terrain with slope angles of the order of 4 ° and rugged terrain with slope angles of about 6 °. The evaluation of the quality of digital elevation models built according to airborne laser scanning.

**Key words:** digital terrain model, digital terrain model, airborne laser scanning, quality assessment of digital elevation models.

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## **METHODICAL PECULIARITIES OF PROGNOSTIC MATHEMATICAL MODELLING FOR DEFORMATION SURVEY OF HIGH DAMS**

*Natalia N. Kobeleva*

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Senior Lecturer, Department of Physical Geodesy and Remote Sensing, phone: (383)343-29-11, e-mail: n.n.kobeleva@mail.ru

The compulsory condition of diagnostic control of dams is the creation of prognostic mathematical models in accordance with the accepted "methodology of safety criteria determination of hydraulic engineering structures" [1] and recommendations of federal law.

With the development and evolution of numerical survey methods and calculating means there appeared the opportunity to survey the condition of structures on the new more detailed level. The created models of tense deformation condition of hydraulic structures due to actual loads: hydrostatic pressure, temperature, seepage condition etc. describe in details the condition of structures from field studies data. However one should be careful to use them to predict deformations.

Modern Hydro Power Stations are the biggest structures on the planet, and their impact on the nature and the nearest landscape is most significant. When creating mathematical models for deformation survey of hydraulic engineering structures it is necessary to choose correctly the right

form and method of mathematical description of the process being studied, to determine the necessary extent and accuracy of survey, to work out careful prognostic method and the efficiency of final results.

The article describes methodical peculiarities of prognostic models' creation for high dam deformation survey.

**Key words:** prognostic mathematical model, geodetic data, hydraulic engineering structures, prognosis, dynamic models, recurrent models of 1 and 2 order, parametric model identification, deformation process.

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## RESEARCH OF LASER SCANNING TECHNOLOGY AT ENGINEERING GEODESIC SURVEYS FOR REPAIRING MOTORWAY

*Ivan S. Kamnev*

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D. Student, Department of Engineering Geodesy and Mine Surveying, phone: (983)311-66-49, e-mail: kamneviv@mail.ru

In this article, the application of the laser scanning technique in the highway surveying for the repair is considered. The measured are analyzed and the accuracy of the laser scanning data is estimated by comparing them with the topographic elevation data resulting from geometric leveling of the road axis. Also recommendations are given for field survey of terrestrial laser scanning to accuracy increase of measurements and increasing the effectiveness of geodetic survey. The investigation of accuracy the quantities measurement of milling and the new materials for the roadway replacement is made, depending on the density of the digital 3D terrain model of the road surface created by laser scanning data.

**Key words:** laser scanning, engineering-geodetic surveys, accuracy estimation, digital relief model, evenness, volume determination.

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## THE RECOMPUTATION OF THE COORDINATES OF THE PROJECTION OF GAUSS – KRÜGER COORDINATES IN STEREOGRAPHIC PROJECTION OF THE GAUSS IN THE CASE OF SOUTH KYRGYZSTAN

*Dinara A. Abzhaparova*

Osh State University, 714000, Kyrgyzstan, Osh, 31 Lenin St., Associate Professor, phone: (996-03-222)5-45-65, 996 777-85-95-05, e-mail: 0777859505@mail.ru

At present the specialists of the GIS Centre of the Republic of Kyrgyzstan (RK) actively exists the implementation of GNSS technologies. The placement of base stations in the Republic of Kazakhstan was started in 2011, and to provide a common coordinate system of the Kyrgyz Republic government resolution of 7 October 2010 No. 235, introduced a new unified state "coordinate system Kyrg-06". The novelty of the article is that in return to the classical method of transition on a plane, it is proposed stereographic projection of the Gauss. Its use increases the performance of topographic and geodetic works, as well as automatiseret the production process of surveying for the recomputation of the shooting. The article method was described for the South of Kyrgyzstan, but it can be used for other areas. The size of the processed media can also vary from consisting of several small base stations (local) to cover the whole country to the extensive national.

**Key words:** engineering and surveying work, stereographic projection, geodetic network, coordinate system, projection, Gauss-Krüger, reduction of distances, GNSS, GIS, mathematical processing, ellipsoid.

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# CARTOGRAPHY AND GEOINFORMATICS

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## CURRENT MOTION OF CONTINENTAL PART FOR FAR-EAST OF RUSSIA BY GPS METHOD

### *Vladimir Yu. Timofeev*

Trofimuk Institute of Petroleum Geology and Geophysics of Siberian Branch Russian Academy of Sciences, 630090, Russia, Novosibirsk, 3 Akademika Koptyuga Prsp., Dr. Sc., Chief Researcher, e-mail: timofeevvy@ipgg.sbras.ru

### *Dmitriy G. Ardyukov*

Trofimuk Institute of Petroleum Geology and Geophysics of Siberian Branch Russian Academy of Sciences, 630090, Russia, Novosibirsk, 3 Akademika Koptyuga Prsp., Ph. D., Senior Researcher, phone: (383)335-64-42, e-mail: ardyukovdg@ipgg.sbras.ru

### *Pavel Yu. Gornov*

Kosigin Institute of Tectonics and Geophysics Far Eastern Branch of Russian Academy of Science, 680000, Russia, Khabarovsk, 65 Kim Yu. Chena St., Ph. D., Senior Researcher, e-mail: gornov@itig.as.khb.ru

### *Anton V. Timofeev*

Trofimuk Institute of Petroleum Geology and Geophysics of Siberian Branch Russian Academy of Sciences, 630090, Russia, Novosibirsk, 3 Akademika Koptyuga Prsp., Researcher, phone: (383)335-64-42, e-mail: timofeevav@ipgg.sbras.ru

### *Maxsim G. Valitov*

Il'ichev Pacific Oceanological Institute Far Eastern Branch of Russian Academy of Science, 690041, Russia, Vladivostok, 43 Baltiyskaya St., Ph. D., Chief of Laboratory, e-mail: maxval@mail.ru

### *Elena V. Boyko*

Trofimuk Institute of Petroleum Geology and Geophysics of Siberian Branch Russian Academy of Sciences, 630090, Russia, Novosibirsk, 3 Akademika Koptyuga Prsp., Ph. D., Researcher, phone: (383)335-64-42, e-mail: boykoev@ipgg.sbras.ru

In this work the preliminary estimate of crustal displacements at Far East region of Russia is shown. Local Geodetic Network for space geodesy is presented at 2003-2014 period. Kinematics parameters induced by strong earthquakes or geological structure are discussed. Analysis of the far-field crustal displacements caused by the 2011 Great Tohoku earthquake inferred from continuous GPS observations. Co-seismic jump up to 40 mm is registered at far-zone of Tohoku event. Irregular horizontal velocities are observed from 0,2 mm/y to 3,3 mm/y level.

**Key words:** space geodesy, GPS-method, co-seismic motion, kinematic of fracture zone of crust.

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## **MAPPING OF LANDSCAPE STRUCTURE OF OLHKHON ISLAND AND PRIOLHKHON REGION BY MULTI-TEMPORAL SATELLITE IMAGES LANDSAT**

***Yulia G. Nikitina***

Irkutsk National Research Technical University, 664074, Russia, Irkutsk, 83 Lermontov St., Applicant, Department of Mine Surveying and Geodesy, phone: (395-2)40-51-02, e-mail: yul-nikitina@mail.ru

***Boris N. Olzoev***

Irkutsk National Research Technical University, 664074, Russia, Irkutsk, 83 Lermontov St., Ph. D., Associate Professor, Department of Mine Surveying and Geodesy, phone: (395-2)40-51-02, e-mail: bnolzoev@yandex.ru

Set and achieved the aim of the study: the information obtained on the structural variation landscape of a forest compartment using satellite images and displays it on the map. While this definition: "spatial-temporal structure of the landscape, "structural variability of a landscape."

The article suggests a methodology and the technological scheme of GIS-based mapping of the structural variability of the landscapes of Baikal national Park based on automated interpretation of multispectral satellite images of Landsat. During the work the following methods were used: processing and interpretation of multi-temporal satellite imagery, GIS processing, statistical analysis, comparison of the results.

The calculated sum of squares and weighted percentages of areas classes change in each landscape partition. Also reviewed content created maps: "Map of NDVI changes in the landscapes of Olkhon island and Preagonal the period of 2009-2015", "Map weighted average of the structural variability of the landscapes of Olkhon island and Olkhon region in the period 2009-2015".

It is concluded that multi-temporal space images of medium resolution provide the ability to perform spatial-temporal analysis of the condition of the landscape.

**Key words:** the structural variability of landscapes, the weighted average percentage, automated processing and interpretation of space images, the method and technological scheme of GIS mapping, maps contents, Pribaikalsky National Park.

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## AUTOMATION AND USE OF RETROSPECTIVE MAPS OF LAND REGISTRATION

**Andrew N. Beshentsev**

Baikal Institute of Nature Management SB RAS, 670031, Ulan-Ude, 6 Sakhyanovoy St., Dr. Sc., Professor of RAS, Head of Laboratory, phone: (3012)433676, e-mail: abesh@mail.ru

The article presents the results of the use of retrospective cartographic materials for land use registration in the geoinformation study of nature management and transformation of natural landscapes in

the central part of the Lake Baikal basin in the 20th century. Comprehensive comparative analysis of retrospective maps with modern maps similar to thematic content and scale is given. The characteristics of retrospective maps are given, their suitability as documents for long-term monitoring of regional nature management and transformation of natural landscapes is assessed. A methodology for geometric correction of retrospective object layers in the Arc GIS software environment was developed. A technique for automating retrospective maps based on geoinformation technology has been developed. An example of the final map of land use monitoring in the Lake Baikal basin is presented.

**Key words:** retrospective maps, cartographic monitoring of land use, GIS-technology, geometric correction.

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## **CALCULATING THE BODIES' VOLUME IN THE TASKS OF APPLIED GEOINFORMATICS**

**Igor' G. Vovk**

Dr. Sc., Professor, e-mail: vovkig383@rambler.ru

**Anna A. Epifantseva**

OOO «Exlinguo», 630091, Russia, Novosibirsk, 39 Romanova St., e-mail: Anuta\_m@rambler.ru

Calculating the volume of bodies is necessary in everyday human activities. You can find multiple methods to solve this problem in the literature on classical geometry and mathematical analysis. But it is very difficult to calculate volume of bodies with complex geometric shapes and find a solution with required accuracy. The article offers an examination of a method used to calculate the volume and/or the size of some bodies, which is based on some certain numerical sequence drawn up to assess the volume and/or the size to be calculated 'from above' as well as 'from below'. It allows evaluating limiting measurement error in the process of volume calculation and completing this process in achieving the required accuracy. Here are quoted the results obtained by means of calculating the bodies' volume and/or their size through the use of this method. The results of the calculating experiments have been compared to those obtained when calculating the volume and/or the size according to some analytical formulas. The results which have been obtained here have demonstrated the fact that this method enables our calculating the volumes of bodies with some certain accuracy quite acceptable for practical purposes whereas the number of operations which are necessary is rather small.

**Key words:** body volume, calculation 'from above', 'from below', limiting measurement error, numerical sequences, number of iterations.

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## CREATION OF GEOINFORMATION RESOURCE FOR PLANNING OF FOREST HARVESTING PRODUCTION

### *Aleskandr P. Mokhirev*

Lesosibirskiy Branch of Siberian State University of Technological University, 662543, Russia, Lesosibirsk, 29 Pobedy St., Ph. D., Associate Professor, phone: (913)181-89-19, e-mail: ale-mokhirev@yandex.ru.

### *Elena V. Goryaeva*

Siberian Federal University, 660041 Russia, Krasnoyarsk, 82 Svobodny Pr., Ph. D., Associate Professor, phone: (908)019-32-13, e-mail: gor-elka@yandex.ru.



**Pavel A. Egarmin**

Lesosibirskiy Branch of Siberian State University of Technological University, 662543, Russia, Lesosibirsk, 29 Pobedy St., Ph. D., Associate Professor, phone: (983)611-30-42, e-mail: egarmin@krasmail.ru.

Forest industries in finding forest land for rent, do not have access to structured information on the state of the site and its characteristics (distance from industrial centers, the possible ways of transporting the wood to the processing sites, data on species composition and quality of the wood at the site, the site relief, transportation path located at the site, soil structure of the site, the information on protective and exploitation forests, etc.). For effective planning and organization of timber harvesting production must have structured information about the resource base for qualitative analysis and modeling of the logging process. The most complete information of its quantity, quality, location, availability of forests in the area can be found on the basis of the geographical approach. The most effective way to assemble all the necessary information in an accessible form and submit it to the end user is the development of a specialized geographic information system for forest users. The paper presents the experience of creating specialized geographic information system based on Arc GIS for Desktop software for Krasnoyarsk Krai, containing map layers (boundaries of forest districts of Krasnoyarsk Krai, road network, railways, hydrography, the rental base, slopes, topography, associated with fire risk areas, soil map, species composition of forests, quarter net of forest districts, specially protected natural territories. Using this information, forest user can perform wide range of tasks in planning and conducting forest management activities on the leased forest areas, as well as to solve problem of choosing forest areas for future rent, delivery of raw materials, availability of information on forest resources.

**Key words:** GIS-technology, GIS resource, cartographic materials, forest use, management of forest resources, forest parcel, planning timber production.

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# LAND MANAGEMENT, CADASTRE AND LAND MONITORING



## ON THE GEOINFORMATION ROLE IN CIVIL-LEGAL PROBLEMS OF ESTATE STATE REGISTER DATA PUBLIC RELIABILITY (ON THE EXAMPLE OF IRKUTSK REGION)

*Alexander P. Karpik*

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Dr. Sc., Professor, Rector, phone: (383)343-39-37, e-mail: rector@ssga.ru

*Yulia V. Fedorenko*

East-Siberian Geodesic Enterprise, 664007, Russia, Irkutsk, 30/1 Sofia Perovskaya St., Juridical and Expert Department Leader, phone: (3952)29-57-88, e-mail: expert-vsgp@mail.ru

*Darya V. Parkhomenko*

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Senior lecturer, Department of Legal and Social Sciences, phone: (383)361-01-09, e-mail: dara8@inbox.ru

From scientific and practical points of view, the article analyses the obstacles impeding the implementation of the Unified Real Estate State Register (URESР) data public reliability principle in Russia. The issues of filling the URESР information if data contradict other Federal information resources. Judicial practice for the protection of Federal real estate property in cases of forest lands and agricultural lands double accounting analyzed (on the example of Irkutsk region). The main causes of land disputes in the modern period researched. The rights protection effectiveness by resolving individual disputes in the courts is discussed. The need to strengthen the geo-information role in the ordering data in the state registries is substantiated.

**Key words:** geo-information, earlier registered land parcels, Unified State Real Estate Register, state forestry register, state data holding, real estate cadastre, land double accounting, out of register rights.

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## OPPORTUNITY OF GIS TECHNOLOGY CLOUD FOR IMPLEMENTATION OF A SINGLE REFERENCE INFORMATION SPACE UNIVERSITY

### *Valentina A. Budarova*

Industrial University of Tyumen, 652000, Russia, Tyumen, 38 Volodarskogo St., Ph. D., Associate Professor, Department of Land Management and Cadastre, e-mail: budarova@bk.ru

### *Yulia D. Medvedeva*

Industrial University of Tyumen, 652000, Russia, Tyumen, 38 Volodarskogo St., Ph. D. Student, Department of Land Management and Cadastre, phone: (919)936-13-78, e-mail: yul.medwedewa2013@yandex.ru

### *Nikita A. Bessilnyy*

Industrial University of Tyumen, 652000, Russia, Tyumen, 38 Volodarskogo St., Ph. D. Student, Department of Land Management and Cadastre, e-mail: nik.bessilnyy@mail.ru

Nowadays computers are the most popular in the human life. There are a lot of Russian universities training highly qualified specialists in the field of geographic information systems (GIS) is conducted at several levels: undergraduate, specialty, graduate and postgraduate (training of highly qualified personnel). They have a person skilled in the field of GIS.

To review and further study of GIS technology, students in practical classes and seminars perform various tasks with the help of computer applications, primarily in MapInfo Professional. At the same time the more practice the students will be, the more they will become competent professionals.

The article provides the development and the initial data for the scientific and educational geoinformation portal of Tyumen Industrial University, whose purpose – placing, storage, and free on-line access to diverse educational, scientific and reference spatial data on the territory of the urban district of the city of Tyumen

**Key words:** GIS, web technologies, spatial data infrastructure, geoportal, agricultural lands, planning area.

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# THE RESULTS OF DATA QUALITY IMPROVEMENT IN UNIFIED STATE REGISTER OF REAL ESTATE ON THE TERRITORY OF NOVOSIBIRSK REGION

*Mikhail P. Dorosh*

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D. Student, Department of Cadastre and Territorial Planning, phone: (383)266-00-39, e-mail: [doroshmp@mail.ru](mailto:doroshmp@mail.ru)

The Unified State Register of Real Estate (further – USR of RE) has been legally exiting from 01.01.2017, but actually it is necessary to complete the data flow from the Unified State Register of Real Estate Rights and Deals (further – USR of RERD) and State Real Estate Cadastre (further SREC), that is, the transfer of data from the given inherited information systems with the condition of simultaneous assurance of completeness, quality and authenticity of these real estate objects data being transferred and integrated.

The data flow (migration) is planned to be completed by July 2017, however the existing migration results highlight the overall picture of data completeness and quality on the Novosibirsk Region territory, and also serve as the quality work evidence of verification and harmonization of data from USR of RERD and SREC both in corresponding cadastral numbers and harmonizing essential features of real estate objects from USR of RERD and SREC in relation to each other.

**Key words:** the Unified State Register of Real Estate, USR of RERD data migration, verification and harmonization of data from USR of RERD and SREC, information completeness and authenticity, right register, cadastral control, data quality improvement.

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## **THE MAIN APPROACHES OF CONDUCTING THE REGISTRATION SYSTEM ON THE EXAMPLE OF «A UNIFIED REAL ESTATE COMPLEX»**

***Olga S. Dudinova***

Novosibirsk College of Geodesy and Cartography, Russia, 630091, Novosibirsk, 9 Krylova St., Teacher of the Highest Category, Head of Full-time Department, phone: (833)221-26-69, e-mail: dudinowa-a@rambler.ru

Introduction in the Civil code of a new object of the corporeal rights – the single immovable complex (ENK) is intended to simplify the procedure of registration and to increase efficiency of turnover of complex infrastructure facilities. The practical demand and efficiency of application of a design of ENK in civil circulation will be determined in many respects by refining and enhancement of relevant provisions of the land and town-planning legislation, legislation concerning the cadastral registration and registration of the rights to real estate. This article is devoted to changes in Art. 133.1 of the Civil Code of the Russian Federation directed to implementation of the idea of creation of a single immovable complex which components are united by an overall objective of use. Creation of the universal information resource containing all information base of real estate objects and data on all urgent and stopped liabilities of owners allows to receive well-defined rules of rendering the state services, the exhaustive list of documents, a detailed regulation of services,

reducing terms of rendering the state services that completely modernizes accounting and registration system.

**Key words:** unified real estate complex, enterprise, parcel, registration system, cadastre, real property, unified state register of rights, the unified state of real estate register, technical plan, Federal information address system.

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## **SUSTAINABLE LAND MANAGEMENT ON THE INTENSIVELY DEVELOPED TERRITORIES**

***Tatyana A. Lebedeva***

Ural State Mining University, 620144, Russia, Yekaterinburg, 30 Kuybysheva St., Ph. D., Senior Lecturer, phone: (343)257-34-64, e-mail: taranova.ekb@bk.ru

***Anatoliy I. Gagarin***

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Associate professor, Department of Business Process Management, phone: (383)210-95-87, e-mail: kaf.zn@ssga.ru

***Yuriy V. Lebedev***

Ural State Mining University, 620144, Russia, Yekaterinburg, 30 Kuybysheva St., Dr. Sc., Professor, Head of the Department of Geodesy and Cadastre, phone: (343)257-34-64, e-mail: taranova@ukr.net

In article methodical scientific approaches whis forming steady land use in intensively developed territories are considered. The advanced methodology of steady land use on the base of biotic regulation of the environment and of the hierarchy management's levels of steady land use is offered. On the basis of this methodology the scientific and methodical principles of steady land use are considered: reasons for strategic priorities and indicators, complex (ekologo-economic) assessment, determination of "corridors" of admissible land use, coordination of interests of individual land users and public concerns, multicriterial (cross-disciplinary) optimization of multi-purpose land use. Strategic priorities and indicators of steady land use depend on the ecological, economic

and social conditions and forms of land use. Ecological and economic evaluation of land resources is based on physical indicators, technological and technical parameters, economic equivalents and complex criterion. Determination of "corridors" of admissible land use is made in ecological, economic and social parameters. Individual interests of land users are manifested on rather short periods of time, and public preferences are expressed in continuous, long-term land use. The search for optimal sustainable land management variants unconsists in disclosure of uncertainty optimal solutions for particular criteries in multicriterial decision on reasonable concessions.

**Key words:** steady land use, intensively developed territories, methodology of steady land use, the principles of steady land use, biotic regulation, hierarchy of management, strategic priorities, complex assessment, "corridors" of land use, individual interests.

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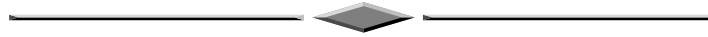
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# OPTICS, OPTICAL AND ELECTRONIC DEVICES AND COMPLEXES



## PHOTON JETS IN THE SCIENCE AND TECHNICS

### *Igor V. Minin*

Siberian State University of Geosystems and Technologies, Russia, 630108, Novosibirsk, 10 Plahotnogo St., Dr. Sc., Professor, Department of Metrology and Technology of Optical Production, e-mail: prof.minin@gmail.com

### *Oleg V. Minin*

Siberian State University of Geosystems and Technologies, Russia, 630108, Novosibirsk, 10 Plahotnogo St., Dr. Sc., Professor, Department of Metrology and Technology of Optical Production, e-mail: prof.minin@gmail.com

The review is devoted to one of most intensively developing sections of optics – to photon jets. The general concept of a photon jet is formulated and the basic characteristics which concern to the given section of a science are resulted. Are considered dielectric mesoscale the particles forming photon jets with axial and without axial symmetry. The basic directions of researches and areas of practical application of the phenomenon of «photon jet» from an individual particle, and array particles are shined.

**Key words:** a photon jet, mesoscale the particle, nanofotonics.

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## RELAXATION IONIC CHARGE IN THE OXIDE FILM ON THE GATE POLYSILICON WITH INHOMOGENEOUS ABROAD WHEN YOU EXIT TO THE OPERATING MODE MOS A MATRIX OF PHOTODETECTORS

**Gennady V. Perov**

Siberian State University of Telecommunications and Informatics, 630102, Russia, Novosibirsk, 86 Kirov St., Ph. D., Associate Professor, Department of Computer-Aided Design System, phone: (383)269-82-59, e-mail: perov@nzpp.ru.

**Valery I. Sedinin**

Siberian State University of Telecommunications and Informatics, 630102, Russia, Novosibirsk, 86 Kirov St., Dr. Sc., Professor, Head of Department of Computer-Aided Design System, phone: (383)269-82-68, e-mail: sedvi@bk.ru

**Marina P. Egorenko**

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Senior lecturer, Department of Nanosystems and Optics Engineering, phone: (383)343-91-11, e-mail: e\_m\_p@mail.ru

Currently, the production of infrared technology, devices and systems in the developed countries has reached enormous proportions and become a separate industry. Amount of expenses for creation and production of infrared devices only military in NATO countries billions of dollars a year.

The design of complex IC devices, the vector of development – increase in matrix size and resolution, sensitivity. Increasing the size of the matrix is accompanied by scaling its elements to topological sizes up to 1 micron. Element base is filled with mostly transistor structures having a layered architecture. In this regard, the scientific interest are the electrical processes occurring at the interfaces of the layers of the changing terrain.

In the article the model of ionic charge in the relaxation of the oxide films with inhomogeneous boundary in the interlayer insulation gate accumulation and transfer photodetector cells in the mode switching matrices FPU based MOS structures. The methodology for determining the boundaries of the critical configurations inhomogeneous dielectrics and gate transistors accumulation and transfer of large-format matrices.

**Key words:** structure and composition of silicon PD matrix, an oxide of polysilicon, silicon oxide charge mobile relaxation, the electrical properties of the oxide of polysilicon, the heterogeneity of the oxidized polysilicon.

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## **THEORITICAL FUNDAMENTALS OF THERMOGRAPHIC RESEARCH MEANS OF CYCLIC DAMAGEABILITY OF METALS**

**George A. Kurilenko**

Novosibirsk State Technical University, Russia, 630073, Novosibirsk, 20 K. Marx Avenue, Dr. Sc., Professor, Department of Strength of Aircrafts, phone: (383)346-17-77, e-mail: teormech@ngs.ru

**Valeric S. Ayrapetian**

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Dr. Sc., Head of the Department of Special Devices and Technologies, phone: (913)462-10 75, e-mail: v.hayr100011@mail.ru

The purpose of the work: elimination of some contradictions in the energy approach to the study of cyclic damage and the development of a new thermodynamic method that makes it possible to increase the accuracy of predicting the accumulation and development of damage.

Research method: a thermographic method for predicting the cyclic strength of structural elements based on the kinetics of a passive thermal field formed on the surface of a component under its test loading is developed. As the parameter of damageability, the increment of the specific entropy in the lesion center during the cycle of oscillations is used. Such a parameter was chosen because entropy is a state function that most fully takes into account all irreversible processes, including damage development processes.

Derivation of the calculated formulas: the entropy flux is decomposed into functional parts: going for heating, for the safe movement of dislocations and for the development of cracks. In doing so, we relied on the deformation criteria of fatigue failure, according to which, when working to the endurance limit in the lesion focus, only non-hazardous entropy is produced, and when working beyond the endurance limit, part of the entropy produced goes to the development of damageability. These entropy fluxes are calculated from the kinetics of the temperature of the source of damage and the energy absorption coefficient.

Results. The proposed thermographic method has advantages in accuracy and productivity in comparison with the known methods due to the fact that the temperature field on the surface of the tested object is fixed with high accuracy in a non-contact way using modern infrared technology.

**Key words:** cyclic strength, temperature, specific entropy, passive thermal field, fatigue resistance, thermographic method, macroelastic deformation, endurance limit.

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## METHOD OF MEASUREMENT S-PARAMETERS OF TWO-PORT MICROWAVE, INTENDED FOR INCLUSION IN MICROSTRIP

**Sergei V. Savelkaev**

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Dr. Sc., Professor, Department of Special Devices and Technologies, phone: (383)361-07-31, e-mail: sergei.savelkaev@yandex.ru

**Svetlana V. Romas'ko**

Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Assistant, Department of Metrology and Optical Engineering Technologies, phone: (383)361-07-45, e-mail: s\_romasko@mail.ru

In the article the principle of the simulator-analyzer, which provides simulation of microwave amplifiers and oscillators in a coaxial of meter tract in accordance with their terms of reference and then measuring the complex loads reflection coefficient of the active ingredient of these devices for the subsequent design in microstrip design. The patient was discharged mathematical model simulator analyzer, as well as its mathematical model calibration. In addition, we consider a method of analysis of the active ingredient stability in the space of his loads complex reflection coefficient, which facilitates the selection of these loads and the most active component in simulations of amplifiers and oscillators. In addition, the possibility of using the simulator analyzer for the measurement of the complex reflection coefficient at the input and output of the loaded active ingredient, as well as measuring its complex transmission coefficients, which together with the measured complex coefficients it loads reflection enable the proposed method to determine the  $S$ -parameters of the component, which he I would have when incorporated in a microstrip line.

**Key words:** simulator analyzer, active four-poles microwave, mathematical model, calibration, complex reflection coefficients and transmission,  $S$ -parameters, an adequate measurement of  $S$ -parameters, amplifiers, oscillators.

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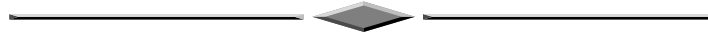
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# ECOLOGY AND ENVIRONMENTAL MANAGEMENT



## THE CONDITIONS OF FORMATION OF RESOURCES OF HEAT AND MOISTURE, AS THE FUNCTIONING AND SUSTAINABILITY OF THE NATURAL SYSTEMS OF THE WEST SIBERIAN NORTH

*Natalia L. Ryapolova*

Omsk State Agrarian University named after P. A. Stolypin, 644008, Russia, Omsk, 1 Institutskaya Square, Senior Lecturer, Department of Environmental Engineering, Water Management and Protection of Water Resources, phone: (913)655-62-97, e-mail: natalyaan1986@rambler.ru

The implementation of the principle of commensuration and balance production and natural potentials requires a quantitative assessment of the environmental characteristics of the territory. The formation, functioning and resilience of natural systems decisively depends on a combination of ecological and geographical factors, regional and local scale, the main ones are resources heat and moisture areas. Research of conditions of formation of resources of heat and moisture the natural systems of the West Siberian North is of scientific and practical interest, as the national strategy for sustainable development provides for the preservation of bioproductive environment in natural-technogenic systems formed in areas of new development. To the effects of economic activity not led to irreversible changes in life-supporting natural resources systems in the study region, it is necessary to assess the current state of their prirodovedeniya elements – the resources of heat and moisture. The article shows a methodical approach and the results of the hydrology-climatic calculations to determine the ecological and geographical parameters and characteristics of the natural systems of the region.

**Key words:** resources heat and moisture, landscape sphere, heat power resources, the maximum possible evaporation, evapotranspiration, moisture ratio, water-balance calculations, the stability of natural systems.

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