A COMMON QUALITY ASSESSMENT FRAMEWORK FOR ENVIRONMENTAL OBSERVATION DATA

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ABSTRACT

We present a common data framework for processing and assessing environmental time-series data. Workflows are designed to handle various ways of data importing and processing observation data. This includes data from the TERrestrial ENvironmental Observatories (TERENO) observatory infrastructure and from external agencies. The implementation of the workflows is realized with an observational data model describing different aspects of data quality assessment and a profile of the Sensor Observation Service (SOS) providing these descriptions along with observation data.

Keywords: Quality Assessment, Observation Data, Sensor Web Enablement, TERENO

ANALYSIS OF BOUNDARY CONDITIONS OFFSET FOR THE ACCURACY OF THE NUMERICAL MODEING OF THE LEVEES

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ABSTRACT

Numerical modeling of important stage during planning construction of bridges, levees, tunnels or any others ground and underground building, that may have affect on the neighborhood and human life. Influence of boundary condition on accuracy of numerical calculation is an example of a modeling part, that cannot be omitted.

Accuracy and time computing of calculation strongly depend on dimension of analyzed model. Rare computational grids considerably decrease resolution and quality of calculation, whereas big size of numerical computational grids rapidly increase calculation time. One of the method of changing size of model is optimize distance to the edge of model interpreted as boundary conditions. Determination of such distance should be compromise between computational cost and minimize of the influence of the model boundaries on numerical calculation under the levee and its nearest neighborhood.

In this paper results of numerical modeling, with different boundary condition offsets are presented in order to find the optimal one. Calculation was conducted using Itasca FLAC v.7.0 2D

Keywords: boundary conditions, numerical modeling, levee

AUGMENTED REALITY AND REVERSE ENGINEERING AS INNOVATIVE APPROACHES FOR PLANNING AND MODELLING THE SUSTAINABLE RECONSTRUCTION OF BUILDINGS

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ABSTRACT

The aim of the paper is to analyse the possibilities and advantages of using the information model created with support of innovative approaches and tools in the field of building reconstruction. Integration of innovative approaches, progressive methods and tools into the process of designing, modelling and planning the parameters of reconstruction projects have to simplify work and increase the quality, efficiency and sustainability of construction projects. The augmented reality and laser scanning as a tool of reverse engineering improves the collection of missing project documentation data and provides a basis for creating a building information model. The implementation of augmented reality and laser scanning in the building reconstruction projects could optimize the communication between project teams and clients, total cost of building reconstruction, time of the projects and plan the optimal structural and technological parameters of building reconstruction.

Keywords: reconstruction of buildings, information model, augmented reality, reverse engineering

BOLIVAR: SIMILATION ENGINE FOR MULTIVARIATE EXTREME ANALYSIS OF METOCEAN EVENTS

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ABSTRACT

BOLIVAR problem solving environment (PSE) is the multi-functional computational software for the researches and engineers who explore the extreme environmental conditions to design and build offshore structures and floating objects. It contains a set of computational modules of various methods for extreme analysis, and a set of modules for the stochastic and hydrodynamic simulation of metocean processes. The PSE is useful for versatile assessments of extreme estimates obtained by different methods and datasets. The application to Baltic Sea wave and wind extremes is discussed.

Keywords: metocean process, extreme analysis, return period, stochastic simulation, uncertainty, problem solving environment, computational cloud, composite application.

CARTOGRAPHIC MODELING BASED ON AN OBJECT-ORIENTED AND DECLARATIVE MULTI-PARADIGM

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ABSTRACT

The literature relating to cartography highlights the longevity of some of the most fundamental problems with modeling selected elements of the natural environment of the Earth and the interpretation of geographic information. Good representation supports the exploration and understanding of the phenomena occurring in the specified area of the real world and provides knowledge about the phenomena studied. New methods for creating maps as models of the world are being continually developed supported by advances in technology. The digital map, among the many forms of specific models, has a special place and has made possible the solution of many previously unsolved problem. A particular challenge is to create a model to represent the social phenomena and their impact on economic development and the environment. The aim of the author's research is, therefore, to develop a method for creating spatial models that allow the representation of complex socio-economic and natural processes. During the implementation, a formulated objective was prepared and tested using the intelligent spatial decision support system to optimize the development of the risk of social marginalization of rural areas. The system allows the storage of the cartographic modeling process without use of algorithms, taking account of both qualitative and quantitative traits. Here, the map is treated not only as a final result, but also as a whole, functioning in the computing environment. In this form the map is both a model of the studied phenomena, as well as research tool that allows testing of hypotheses and predictions. This functionality has been achieved as a result of extending an object-relational data model, which is the basic model of digital mapping data, with the characteristics of deductive reasoning. It also allows for dynamic creation of thematic maps representing an effective tool for the decision-making process, which cannot be structured and thus described in the form of an algorithm. Which makes the modeling of spatial data also effective in terms of representation of social phenomena and their impact on nature and the economy.

Keywords: spatial model, cartographic modeling, intelligent spatial decision support system, artificial Intelligence, digital map

CLEANWATER ON-LINE SYSTEM FOR WATER QUALITY ANALYSIS

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ABSTRACT

The paper is accomplished in the framework of the LIFE09 ENV/RO/000612 - CLEANWATER project, which foresees the development of an integrated GIS approach for the management of nitrogen pollution, at watershed level; with emphasis on modelling tools and field campaign for analyze the nutrients vulnerable zones. The project facilitates the implementation of Community environmental policy (e.g. WFD Nitrates Directive) at local and regional level, creating a complex watershed database for assess the factors, pressures and responses that impact the water resources. The goal of this paper is to analyze the nitrates pollution from agriculture sources, within the Barlad River Basin, using a GIS approach. Evaluation of human impact using GIS environment offers a global view of the pollution problems at the basin scale and improve the local and central authority's analysis in the field of nutrient management.

Keywords: GIS system, nitrates vulnerable zones, open source software

CLUSTERING ALGORITHM IN ORDER TO FIND ACCIDENT BLACK SPOTS IDENTIFIED BY GPS COORDIANTES

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ABSTRACT

Black spots are areas in the public road network where the number of accidents is significantly higher than expected. There are several methods that may be used to find these black spots, they usually use the road number and road section based positioning system, which is very useful in cases when we want to find black spots in one road only. But it has several disadvantages in the case of junctions, interurban areas, etc. It would better to use GPS coordinates, but the already existing black spot search methods are not applicable in this case. This paper presents a modified DBSCAN based clustering method in order to find accident black spots. DBSCAN is a general clustering algorithm, so it has been adapted to work with road accidents identified by GPS coordinates. We also present a fast and accurate technique, which calculates the accident density in a given area.

Keywords: DBSCAN, clustering, accident, black spot, algorithm

COMBINATION OF LASER SCANNING AND GIS TOOLS FOR QUANTIFICATION OF THE LIMESTONE DEPOSITS IN OPEN-PIT MINES

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ABSTRACT

The article presents the 3D survey of the open-pit mine in order to develop a 3D digital model for identification and quantification of the limestone deposits. The main principle of 3D laser scanning are explained and presented. The computer GIS techniques for data processing and creation of 3D digital model are presented and quantification 3D analysis tool are used to classify deposits in the area of interest.

Keywords: GIS, 3D scanner, estimation, resources

COMPARISON OF SOFTWARE SOLUTIONS FOR AUTOMATIC GENERATION OF 3D BUILDING MODELS

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ABSTRACT

The fields of application of 3D building models are quite various such as 3D city models (visualizations, urban planning), intelligent transportation (smart navigation, augmented reality), environmental monitoring (propagation of road traffic noise, air pollution), special application (propagation of electromagnetic waves for telecommunication applications) and risk management (generation of flood maps). 3D building models have a great importance for specialists from a wide range of disciplines, therefore they are very important.

The most common form of spatial data for the generation of 3D building models is a point cloud. Point clouds can be obtained by active sensors like airborne laser scanning (ALS) systems which use the Light Detection and Ranging (LiDAR) principle or it can be derived by image matching techniques using satellite or aerial images. Both techniques are very modern and progressive methods of non-selective collection of spatial elevation data. Point cloud data represents the surface geometry of an object via independent distribution of points with uniform quality, however, the representation of buildings through point clouds is not appropriate for many applications. Handling with a set of data points covering large areas is difficult and very consuming on hardware. For more sophisticated tasks, a generalization and simplification of the point cloud is necessary. The generation of 3D building models is just such the case.

A major influence on the generation of 3D building models is the density and quality of the point cloud, which is determined by scanning parameters (LiDAR principle) or ground sampling distances and overlaps between images (image matching techniques). The manual processing of point clouds is extremely time consuming and it is impossible to repeat it with the same result due to the human factor. Fully automatic methods of processing are used with increasing amounts of data that can be processed in shorter time periods. These methods of processing are very popular and in demand nowadays. There are several different commercial software products on the market that solve the problem of fully automatic generation of 3D building models. This paper will be a comparison of current commercial software products (ENVI LiDAR and INPHO Building Generator) that process this task. These software products have not yet been compared. Software testing will be performed on three datasets with different densities of point clouds.

Keywords: airborne laser scanning, automatic generation, building models

COMPARISON OF SOIL EROSION RILLS IDENTIFICATION BY MATHEMATICAL MODELS AND AERIAL PHOTOGRAPHS

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ABSTRACT

The importance of soil loss by water erosion becomes more eminent with the ongoing climate change, where more extreme precipitations in middle Europe are anticipated. The amount of soil transported from the field plot can substantially differ according to the intensity of rill erosion. The capability of mathematical models to predict appearance of extreme soil erosion spots on arable land (rills and gullies) are addressed in this paper. Three surface runoff\erosion models were tested by comparing their outcomes with rills identified from orthophoto maps.

Empirical methods are represented by Universal soil loss eq. (USLE). The equation is a simple method of the long term modeling of the sediment yield. Limitations of this method are in estimating soil loss from rainfall episodes and application of this equation in areas with concentrated flow is debatable.

Second tool used is physically based model SMODERP which is being developed on CTU Prague since 1990s. Soil characteristics are based on Czech soil taxonomy system. The model SMODERP is excellent tool for modeling of sheet and concentrated surface runoff. Hydrological part of the model includes the processes of infiltration (Phillips equation), sheet surface runoff (Kinematic wave based equation), rill runoff, surface retention.

Third tested modeling approach is based on Erosion-3D simulation model, developed at TU Freiberg (Germany). Erosion-3D is physically based and fully distributed rainfall-runoff model allowing calculation of transported sediment. The model can be run for single event, repeated events or sequence of events and the outputs include characteristics of runoff and soil transported in three particle size fractions. The soil input parameters are based on German standard of soil classification KA4. The uncertainties in inputs strongly influence the absolute values of soil erosion, but spatial distribution of netto erosion can be useful in identification of rill erosion appearance.

The paper describes validation and application of models at the experimental field plot near Benesov (Central Bohemia, Czech Republic) in 2010. Airborne photographs of the field plot with apparent consequences of a heavy rainstorm event were used to visually derive the pattern of erosion rills and ephemeral gullies which were used for the main comparison. Standardized plots (22.1 m in length, 9 % slope) for long term monitoring of erosion processes have been installed on this experimental field. Outflow from the plots and precipitation are automatically continuously measured during each natural rainfall event. The soil concentration in outflow and the volume of transported sediment

is determined from samples in laboratory. Data from experimental plots can be used for validation of the model's input parameters.

Keywords: SMODERP, Erosion-3D, erosion, modeling, USLE

CONCEPT AND RESULTS OF TESTING ACCURACY OF F5-MVP HANDHELD SCANNER FOR 3D CLOSERANGE MAPPING

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ABSTRACT

At the beginning of 2012 a new measurement instrument was released to the market. It enters in to a lack between close range white light handheld scanners and terrestrial laser scanners. F5-MVP from Mantis Vision Ltd. Is so far one and only handheld structured light 3d scanner on the market with such wide depth range 0,4-4,5m [2,3]. It makes this device unique and reliable for close range mapping. This new functionality creates very wide potential of implementation in many different sectors. This article shows results of investigation of various accuracy tests taken at designed testing stage. Results of those test shows strengths and limitation of this new device.

Keywords: 3d scanning, 3dmapping, survey

CREATION OF DATABASES WITH OPTIMUM STRUCTURE OF POINTS OF INTEREST' OBJECTS FOR AUTO NAVIGATION MAPS

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ABSTRACT

As well as in any new, quickly developing sphere, in digital navigation mapping already the questions connected with improvement of technology of maps' creation now begin to appear. Therefore, in this situation it is very important to pay attention to the process of drawing up navigation maps – to accurate definition of object structure, distribution of objects by layers and levels of a scale row. For the solution of these tasks, we want to offer the technique of digital map bases creation for navigation maps in which the norms of a ratio of elements of a maps' basis established during the research and the thematic contents are considered.

Keywords: navigation mapping, scale row, element of a map's basis

DATA FLOW DIAGRAMS IN GEOGRAPHIC INFORMATION SYSTEMS: A SURVEY

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ABSTRACT

Data flow diagrams (DFD) are one of the oldest graphical representations in informatics. The data flow diagrams can be consider as visual programming language (VPL). Nowadays, geographic information systems (GIS) have some graphical environment that assists in the designing of flow chart model. The article brings an overview of notations and formal semantics for data flow diagrams in GIS. The survey contains software ArcGIS for Desktop 10.2, ERDAS IMAGINE 2013, IDRISI Selva and AutoCAD Map 3D 2014. Beside the commercial software, the open source QGIS 2.2 and its component Processing Modeler is mentioned.

The article concerns more to the graphical notation than the amount of functionality. The graphical notation is important from the point of perception and cognition. The main task of data flow diagrams is to support the batch processing data. The next function is a "graphical report" of steps of processing. From the point of these two tasks, the graphical notation is important. For all that purposes, it is necessary to use cognitively effective visual notations. Cognitively effective means optimized for processing by the human mind. An optimized notation helps to user very quickly understand to the diagram [1].

Keywords: geoinformatics; notation; visual programming language; diagram; cognition; perception.

DATA MODEL FOR MULTIDIMENSIONAL GEOLOGICAL SUBSURFACE DATA IN GEOGRAPHIC INFORMATION SYSTEM

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ABSTRACT

This paper deals with the status of development in the field of creation of digital geological subsurface models and their storage within enterprise databases. Focus is put on software used for creating the models, on data management, and the level of automation of the modeling. Solutions of several geological survey organizations (GSOs) and the latest advances in the research of this topic within the Czech Geological Survey are compared.

The main source of information about subsurface geology in the Czech Republic is the database of boreholes and their logs. Other data sources include traditional 2D geological maps, geological cross-sections, geophysical measurements and interpretations, and results of previous research projects (usually in the form of isolines or grids). Topographical base maps are also used, especially the elevation information in the form of digital elevation model or grid of elevation points. All these sources of information have to be included in the data model.

Most of the mentioned GSOs have been developing their multidimensional models for many years and have come up with their own software solution or a combination of commercial software packages to meet up their needs regarding the purpose of the model, modeling method, scale, requirements for interactive use, visualization etc. The enterprise Geographic Information System (GIS) of the Czech Geological Survey is built upon Esri technologies, therefore our aim is to use this technology for multidimensional data and easily combine them with 2D geoscientific data in the GIS environment. We are testing the possibility to use the extensions to ArcGIS Desktop for these purposes, especially the 3D Analyst and the ArcHydroGroundwater extensions.

The Czech Geological Survey is so far producing regional or local 3D models of subsurface geology, but not in a standardized way and with unified data structure. Our aim is to produce regional to national models with the 3D layer-based approach that would be based on central data administration and that could be further improved or differentiated by a set of attributes or parameters for different applications (groundwater deposits assessment, CO2 storage, etc.).

Keywords: 3D geological model, data model, GIS, geodatabase, subsurface geology

DEMAND SPECIFICATIONS FOR GEODATA WITHIN A PUBLIC TRANSPORT SYSTEM

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ABSTRACT

Development in public transport is closely linked with trend of increasing of offered public services. This aims in competing with individual car traffic and in significant reducing of traffic pollution in cities. Integrated transport systems connect all transport modes into one complex system and provide sufficient quality and affordable offer of transport services for passengers. This paper deals with the content, scope and details of geodata in public transport systems with the use of geoinformation technologies. The aim of this paper is to identify and specify the demands on public transport geodata from different points of view - passengers, carriers and management of public transport. The authors answer the following issues in their research: (1) what information should be provided to passengers to prefer public transport and in what details, (2) what information the carriers need for managing and controlling public vehicles (which form is the best; how many details they need and when), (3) which data are necessary for integrated transport systems (their strategic departments) to compile the strategy plan of managed public transport?

Keywords: public transport, geodata, public services, passengers, geoinformation technologies

DEVELOPMENT OF A GIS APPLICATION FOR ANALYZING AND PROCESSING EXTERNAL FACTORS THAT AFFECTING THE STRUCTURAL BEHAVIOR OF ELECTRICAL FACILITIES

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ABSTRACT

Mexico is located in one region, which is affected for several natural hazards. In many cases, these hazards had caused important economic losses and many deaths. Mexico is located in one of the seismic most active regions of the world, which is the result of the Cocos tectonic plate subducting beneath the North American plate. Such subduction in the Pacific coastal region is usually the cause of large destructive earthquakes, including the great Mexican Earthquake of 1985. On the other hand, Mexico has been devastated throughout its history by hurricanes, which are the worst events of the tropical cyclones, reaching the category of 5 (over 250 kph) in several occasions.

However, there are another phenomena that affect the structural integrity of electrical facilities as corrosion. Corrosion of steel reinforcement is the main cause of damage and early failure of reinforced concrete and steel structures. Structures at the seashore of Mexico experience enhanced deterioration due to bad construction practices such as: the use of high water-to-cement (w/c) ratios, the use of aggregates that in most of the cases present an excess in fine particles, and the custom of making foundations in direct contact with the sedimentary layer of sand and seashell.

In order to carry out risk studies, is necessary to know the type and intensity of the hazard, the structural integrity, and to apply the adequate methodology to relate both concepts. One of the most important stages of this work is collect structural information in situ. For this reason, 162 Electrical Substation of transmission were inspected applying nondestructive tests. The analysis of this information will allow to develop maps, which can be used in the risk studies.

In this paper, a GIS application to manage the information of structures of electrical facilities is presented. The application shows the factors that affect the structural integrity. These factors are grouping in physicals (earthquakes, tropical cyclones, flooding, etc.), chemicals (carbonation, acid rain, drying, etc.) and organic (microorganism, seaweed, pollute waters). The application integrates a qualification

methodology to assess the structural integrity, hazard maps, and restoration and reinforce procedures based on structural qualification. The application will be applied in the nine regions of the country.

Keywords: Natural Hazards, Structural integrity, Nondestructive test, GIS applications, electrical infrastructures

DEVELOPMENT OF CITY NAVIGATION INTELLIGENCE – USING GIS FOR URBAN PLANNING MONITORING AND EVALUATION

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ABSTRACT

Evaluation of development programs, plans, projects is episodic task of local government in two basic complementary forms: ex ante and ex post, whose quality depends on establishment of a continuous monitoring process of territorial changes. Monitoring should enable the information and signaling provision to support both evaluation forms and addressing the problem issues during the implementation process. Experience shows that monitoring functionality means tracking different domains of territorial transformation and several sets of quantitative and qualitative indicators related to planned development targets. However, these reports, because of its sectoral specificities or indirect connection with development goals, are often incomprehensible to the general public. Therefore, some researchers focus is directed towards the development of a new Geographic Information Systems (GIS) functionality: monitoring of communities / cities vital signals that are far more related to existential values of the local community, and therefore more understandable and more acceptable to the general public. This paper provides a critical review of conceptual thinking on the functionalities of GIS based monitoring and review of good practice in the development of technical solutions in this field. The results of this study indicate the need for changes in the approach to designing a web-based GIS applications for monitoring and evaluation.

Keywords: city navigation intelligence, monitoring and evaluation, web based GIS

DEVELOPMENT OF DAMAGE SCENARIOS FOR ELECTRICAL FACILITIES DUE TO TROPICAL CYCLONES, USING GEOGRAPHICAL INFORMATION SYSTEMS

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ABSTRACT

The catastrophic effects on structures during tropical cyclones occur mainly by the combined effects such as extreme winds, high waves and flooding, and a deficient structural capacity of facilities. The electrical sector is affected continually for these phenomena, causing important economic losses, besides, falling trees, and flying debris making contact with overhead power lines result in electrical outages. The magnitude and duration of such outages is worsened if the power lines, poles, underground lines, and above ground electrical facilities fail (when transmission facilities fail, restoring the energy services can take several days).

Federal Electricity Commission (CFE) as leader of the electrical sector in Mexico spends a lot of money, researching how the effects of tropical cyclones can be decreased and, developing mitigation procedures, to reduce the outages of the energy service. Therefore, in this paper, a procedure to assess the possible damage in the electrical sector facilities' subjected to wind forces caused by tropical cyclones is proposed (in a first stage, transmission lines and Electrical Substations were chosen). The procedure is based on simplify models, which were implemented in the Geographic Information System named GECITRO, developed to manage the information about tropical cyclones. The program GECITRO includes a module, with four forecasting mathematical models (GFS, MM5, UNAM and the NHC advisory) in order to calculate the probable tracks of tropical cyclones, and parameters like velocity and directions of wind at different pressure levels, precipitation or temperature for a period of seven days ahead. Besides, the program includes a module to develop damage scenarios, using the forecasting wind velocities of the mathematical models.

The program was programmed using the languages Silverlight, JavaScript, Python, Java, and C++. The database is managed using SQL Server and the service of maps via WEB and mobile device is provided for ARCGIS Server. Actually, the program is used for the hydrometeorological department of the Federal Electricity Commission.

Keywords: Damage scenarios, forecasting models, vulnerability functions, Geographic Information System

DEVELOPMENT OF NASA WORLD WIND BASED APPLICATION TO DISPLAY SENSORS OBSERVATION ACCORDING TO ISTSOS PLATFORM

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ABSTRACT

The Sensor Observation Service (SOS) is a web service to query real-time sensor data and sensor data time series and is part of the Sensor Web [1]. istSOS is a Sensor Observation Service application developed by "Institute Scienza della Terra", for data gathering and service through the usage of the Sensor Observation Service OGC standard [2]. Currently this platform will give the results in a XML format. There is no client-side offered in a user-friendly interface, either desktop or web-based. This implies that for the user to get the information, he/she needs to get the XML file, parse it, and then create tables or charts through one of programming languages or applications that deals with charts. In order for a user to be able to browse easily and same time to get the observing results in a "known" formatting according to some specific criteria set by him/her, we worked towards a more integrated application, especially towards a Java-based application that will be able retrieve information about the sensors and their observation and present them through "user-friendly" interface – globe, based on NASA World Wind application. Consumption of the service is done through URL, the return result of service is XML format, which is parsed and then the information retrieved is inserted in the corresponding developed java classes. The core part of the application (classes, transfer objects, data access objects) is developed by using MVC pattern. These classes then are called through NASA World Wind based application. NASA World Wind based application is developed in a way that that will show the sensors in the globe and through annotations will give observation information for every sensor. The information includes: sensor name, feature of interest, start period of observation, end period of observation and observation values.

Keywords: GIS, Geo-web services, istSOS, SOS, sensor, observation, OGC, NASA Worldwind

EXTRACTION AND APPLICATION OF GEOLOCALIZED DICTIONARIES

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ABSTRACT

The field of natural language processing gains more and more in popularity, especially in the context of the growing demand for discovery of valuable content in continuously growing human generated data. This paper presents a method of geolocalized information retrieval from text with special concern placed on automatic recognition of semantic geolocalized relations, their classification and interpretation resulting in assigning them specific geographical coordinates. The semantic relations are matched against a geolocalized dictionary based on the OpenStreetMap project and stored in a spatial database created by extending PostgreSQL object-relational database with the PostGIS module.

A proof of concept implementation is discussed, using the data stored in the aforementioned spatial database. Its performance according to diverse metrics is presented.

This paper focuses on determining the coordinates of locations in Cracow (Poland) and a spatial reference system (SRS) appropriate to this area was used. However, the presented methods and implemented system may be applied in any other place in the World and use any spatial reference system.

The natural language texts used in the described experiment were in Polish and coming from a real life application being a part of the IBM Smart Cities initiative. The lexical challenges added an additional layer of complexity due to the complex inflectional system of the source language. But it has to be emphasized again that the discussed theory and method of assigning geographical coordinates to a textually described locations, alongside with its implementation, is applicable to any other language.

Keywords: geolocalization, natural language processing, geolocalized relations, geolocalized dictionaries

FORECASTING OF SNOW COVER MELTING RATES IN PERM REGION BASED ON THE RESULTS OF SATELITE MONITORING USING CELLULAR AUTOMATA METHOD

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ABSTRACT

The paper presents problems, which are connected with satellite monitoring of snowmelt process in the Perm region. It is represented research data of 2011, according to which almost every day only a small part of the observed territory can be identified due to the effect of clouds. It is proposed the algorithm, based on cellular automata method allowing forecast snow cover melting in areas, which are not currently available to satellite monitoring. The idea of the algorithm is that each territory "cell" may be in the 5- states: «there is no snow», «presumably there is no snow», «uncertain situation», «presumably there is snow», and «there is snow». Recalculation of the transition from one state to another is based on daily observations. Herewith, it is estimated the probability of the transition for «unobservable» cells. Analysis of observations and forecast estimates has showed that trend of snow cover melting rate coincides with high accuracy in the both cases. This result can serve as indirect evidence of the efficiency of the proposed algorithm.

Keywords: satellite monitoring, snow cover area, cellular automata, forecast.

FOREST TAXATION DATA GEOPROCESSING FOR ASSESSMENT OF FOREST FIRE DANGER CAUSED BY FOCUSED SUNLIGHT

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ABSTRACT

Predicting and estimating forest fire danger is an important part of the system of forest fire prevention and elimination. Geographic information systems (GIS) have instruments for creation, transformation and integration of variables concerned with fire danger. They allow finding geographical and analytical relations to identify areas with high fire incidents probability.

Analysis of existing forest fire danger assessment systems showed that they take into consideration such factors of forest fire initiation as anthropogenic load and storm activity. Theoretical estimates and results of experiments prove that there is possibility of forest fire due to action of focused sunlight along with previously mentioned factors. Assessment of forest fire danger caused by focused sunlight is realizable by analysis of forest taxation description of a given forest area. None of the existing systems recognizes this factor.

This paper describes geoinformation system that includes toolset for analysis of forest areas taxation aimed at quantitative evaluation of forest fire danger. Radiant heat flux is considered to be reference source of ignition. The system is capable of evaluating probability and classification of forestry quarters by level of fire danger. Performance of algorithm of forest fire danger caused by focused sunlight evaluation in geoinformation system is shown on typical forest area of Timiryazevskoe forestry of Tomsk region.

Conceptual basis of GIS system is physically and mathematically proved methodic of forest fire danger assessment. Computational formulae of probability of forest fire initiation are derived from basic statement of probability theory. The system is implemented in specialized software ArcGIS.

The system uses standard user interface with additional functionality for assessment of probability of fire incidents in the forest quarters area caused by focused sunlight. Received information is displayed on the map. For extra capabilities in evaluating forest fire danger unique instruments were developed in built-in Python programming language. Probability maps of forest fire initiation in forest quarters were created using proposed model. Application of these maps will be an important component of the forest fire control system.

Keywords: Geoprocessing, Forest Fire Danger, Forest Taxation Data, Focused Sunlight

FRACTAL ANALYSIS APPLICATION TO THE FLOODPLAIN-CHANNEL SYSTEMS DEVELOPMENT RESEARCH (BY THE EXAMPLE OF THE RIVER BELAYA, THE REPUBLIC OF BASHKORTOSTAN)

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ABSTRACT

The article is devoted to the analysis of the investigation problem of floodplain-channel systems development. It has been found that the study of the natural objects evolution is complicated by comparing data of different map types (classical topological and modern GIS maps). In this regard, for the river Belaya floodplain-channel system research the fractal analysis was applied. At present, this type of analysis has found widespread application in the branched structures investigations (river networks, complexes of lakes and wetlands). In this paper the fractal dimensions of the river Belaya floodplain-channel system and its inflows were calculated according to the data of 1992 and 2009 for three scales (1: 1865306; 1: 3000000; 1: 6000000). The comparison of the obtained fractal dimensions permits to estimate structural changes in the considered floodplain-channel system. Thus, during the analyzed period there was revealed a trend of the fractal dimension reducing at all examined scales. That shows the floodplain meandering decrease and the reduction of its earth's surface occupancy.

Keywords: fractal analysis, fractal dimension, floodplain-channel system.

GPS MEASUREMENT METHODS FOR MEASUREMENT APPLIED IN FORESTRY

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ABSTRACT

The work describes a case study regarding the method to determine the support network as well as the carrying out of the topographic and geodetic works **in connection with the project "Execution of maps and subdivision plans for the vesting in possession of the land area of 103.68 ha covered with forest vegetation on the territory of the Criciova Commune, Timis County by means of mapping and topographic measurements.** In order to solve all the problems related to such works with maximum efficiency, diligence and precision, modern and high-tech methods and pieces of equipment such as total stations and GPS equipment have been used. Furthermore, in order to obtain results as accurate as possible and to provide stability and high reliability of the solutions found, specialised data processing software such as the Leica Geo Office Combined has been used. The software allows data processing and network compensation at the same time.

Keywords: topographic surveys, GPS, subdivision plans, support network

IMPLEMENTATION OF THE SELECTED PRINCIPLES OF THE FUZZY SET THEORY INTO SPATIAL DATABASE SYSTEM AND GIS

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ABSTRACT

Spatial data is very often uncertain. The quality of spatial data is also very variable. The functions and operations which are performed with the data in information systems and object-relational database systems are mostly implemented by the use of crisp rules and criteria based only on Boolean logic. This classical approach often leads to a loss of information resulting from the uncertainty in the input data or decision criteria. Fuzzy sets and fuzzy logic provide a description of uncertainty and allow working with it. Fuzzy sets are usually used in geographical information system (GIS) in raster spatial data analysis only. Vector data analysis by fuzzy sets in GIS environment or spatial database systems could be useful too, but there are only limited capabilities in common GIS tools to use it. This paper deals with implementation of the principles of fuzzy set theory and fuzzy logic into spatial database systems and vector data analysis in GIS. In this paper, we created fuzzy queries by the use of Structured Query Language (SQL) and spatial data types in accordance with ISO 19125-1 and ISO 19125-2 standards. We also used selected fuzzy aggregation operators (e.g., the minimum t-norm, the product t-norm and the Łukasiewicz t-norm) in spatial queries. We implemented the resulting fuzzy spatial queries in the PostgreSQL database system with the PostGIS extension. The result of fuzzy spatial queries is for example a selection of the spatial objects with information about their degree of compliance with the decision criteria (degree of membership in fuzzy set). Data obtain as a fuzzy selection can be further analysed in a GIS software environment. The implementation of the principles of fuzzy sets to spatial database systems and GIS brings an opportunity for instance for the efficient processing of uncertain data or fuzzy criteria in multi-criteria decision making. Spatial data uncertainty modeling is also quite current topic in relation to the integration of heterogeneous geospatial data sources.

Keywords: spatial database, uncertainty modeling, fuzzy sets, GIS, SQL

IMPROVING THE DATA PROCESSING PROCEDURES OF PRECISION GRAVITY SURVEY

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ABSTRACT

The improved procedures for gravity calculation are provided, which can enhance the accuracy and reliability of the observed data. The new reduction procedures take into account modern data of the earth shape. Algorithms for computation are developed within GIS technologies. A case study of gravity survey data processing performed in the south of Western Siberia, shows that the modern processing procedures can increase the information content of gravity data.

Keywords: Gravimetry, gravity reduction

INFLUENCE OF THE SHAPE AND DENSITY OF GRID COMPUTING TO THE ACCURACY OF THE NUMERICAL SIMULATION RESULTS OF THE FLOOD EMBANKMENTS MODEL

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ABSTRACT

Numerical modeling is an useful and frequently applied tool in the design of various types of geotechnical constructions. The progressive development of computer technology allows to perform faster and more accurate analyzes. The most important factor that affect simulation time of numerical algorithms is the rank of compaction of the computational grid. In this paper the analysis of the effect of the density of grid computing numerical model of flood embankments on the computation time are presented.

The accuracy of modeling results for different shapes of assumed computational grid model were presented additionally. The analysis was conducted due to the changes in slope stability factor of the embankment, accidental displacement, strain and total stress state within the modeled object. Numerical computations was conducted with FLAC v.7.0 based on the finite difference method.

Keywords: numerical modeling, embankment, grid density

INTEGRATION NEURAL NETWORKS AND GIS IN MODELING LANDSCAPE CHANGES

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ABSTRACT

Geographical information system is very powerful tool to manage and analyses land use data. The integration of Geographic Information Systems and Artificial Neural Networks offers a mechanism to lower the cost of analysis of landscape change by reducing the amount of time spent interpreting data. Artificial Neural Networks (ANNs) have been proven to be useful in the interpretation of natural resource information. Back-Propagation Neural Networks are one of the most common and widely used architectures. Many architectures and types of ANNs have been developed, and many of them are PC-based. Change prediction is based on the analysis of the Markov chain. This process determines the condition of the system on the basis of its previous condition and likelihood of changes which have occurred between them. Models of change serve as useful tools for exploring the various mechanisms by which land use change occurs actual projecting and potential future environmental and evaluating the impact.

Keywords: Land use change, Artificial neural networks, Geographic information systems

INTELLIGENT GIS FOR MONITORING AND PREDICTION OF POTENTIALLY DANGEROUS SITUATIONS

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ABSTRACT
GIS-oriented systems are often used for enhanced monitoring of environmental situation in oil regions. Such systems allow to analyze, visualize receiving information and what is more to support organizational decision-making processes in various dangerous situations. The paper presents scenario approach to geospatial processes description of dangerous situations in different subject domain.

Ontology, expert system and other artificial intelligence technologies are proposed as basic ones for scenario implementation. The application of scenario-based technique is illustrated via case study of sea oil spill cleanup activity.

Keywords: geographic information system, ontology, scenario approach, expert system oil spill cleanup activity.

INVESTIGATION OF VLBI TELESCOPES GEOMETRY USING LASER SCANNING

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ABSTRACT

In this paper, the methodology of research of the 32-meter radio telescope RT-4 antenna dish measurement belonging to the Institute for Astronomy at Nicolaus Copernicus University in Torun, placed in Piwnice is presented. The measurements were carried out using terrestrial laser scanning technology. Analysis of the results is carried out to determine the deformation of the radio telescope antenna dish with the determination of the impact of external factors on the studied phenomenon. Research described in the article are adopted to the research methodology as well as describe the first measurement session already realized with the preliminary analysis of the data. Ultimately, the study relate to compare methods of measurement using terrestrial laser scanning technology with the holographic method of antenna dish radio telescope measurement in terms of accuracy of results and efficiency of methods is presented. Such a comparison will be the first example of a previously completed joint use of both techniques and innovative way of approach to determine the deformation of the radio telescope antenna dish.

Keywords: radio telescope, terrestrial laser scanning, holography, deformation

LEARNING MOVEMENT HABITS BASED ON GPS TRACKLOGS IN MOBILE ENVIRONMENT

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ABSTRACT

In this paper we are introducing methods applicable in mobile environment (e.g. smartphones) for comparing GPS track-logs of human subjects and identifying regions of space where trajectories are close to each other. Our research focuses on comparing routes of human subjects, extracted from GPS track-logs, in order to identify spatially and/or temporally repeating patterns. In this paper we are introducing an indexing mechanism called *double-mesh*, which was designed to support efficient locating of not only similar trajectories, but sub-trajectories as well. Our proposed method is capable of determining common zones of any number of trajectories with linear complexity over the number of GPS points.

Keywords: Algorithm, GPS, tracklog, trajectory

METHODOLOGY OF DEVELOPMENT OF INFORMATION SUPPORT TO URBAN SUSTAINABILITY ON A LOCAL GOVERNMENT LEVEL IN TRANSITIONAL COUNTRIES – EXPERIENCES OF SERBIA

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ABSTRACT

The experiences of cities around the world underline the fact that the GIS based information systems to support sustainable urban development represent a complex problem for local government, because it tackles not only the issues of technology, but also of institutional, organizational, regulatory and normative framework of information activities at the local level. The experiences of some local governments in Serbia underline as a problem the gap between local/national information culture and globally available technology solutions. Lack of understanding, knowledge and skills to plan and manage the development of information system activities generates misbalance between investment, real needs and cognitive capacities of the community. For this kind of unstructured management problem organizational studies researchers recommend the Soft systems methodology (SSM) that treats the notion of information support as an epistemological rather than ontological entity. This article provides an overview of the experimental results in the application of the SSM in the development of pilot Territorial Information Systems (TIS) in six municipalities in Serbia. The results show that this methodology enables proactive efforts of local government structures, foster achievement of concrete practical results and ensures sustainability and long term progress of the process of social transformation of information activities at the local level.

Keywords: Soft systems methodology (SSM), development of information support to urban sustainability, Territorial information systems (TIS), local governance

MODELLING AND COMPUTER ANIMATION OF GEODETIC FIELD WORK

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ABSTRACT

3D modelling of objects is a way of obtaining information, while the visualization of geospatial data is becoming a production task in the scope of surveying. Visualization of geospatial data provides effective tools for analysis information about the land surface, land cover, its features, properties etc. Computer animations, both 2D images and 3D are becoming additional, expected and clear form for presentation results of geodetic field work. The most frequently presented part of reality in the 3D is terrain relief displayed as Digital Terrain Model – DTM. DTM is now an essential product to start many investment processes. The second most commonly mapped geographical components in 3D are buildings. Terrain modelling is becoming increasingly important, both in scientific and commercial applications. The third dimension of the map enables to recreate reality. Developing relief, buildings and other features is possible because of new technologies like LIDAR or RTK.
Terrain modeling is becoming increasingly important, both in scientific and commercial applications. Using GIS tools enables to conduct studies on geomorphological aspect of landform research, creating cut-edge visualization and many more. The third dimension of the map facilitates intuitive 3D perception, interaction and collaboration with geospatial data. Observer gets an impression of viewing reality. The use of 3D technology allows for the transition from the flat paper map to the virtual map and build three-dimensional models.

Keywords: LIDAR, DEM, 3D modeling, visualization, animations

NEW DIGITAL CRACKMETER CONCEPT

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ABSTRACT

Complex management of construction and engineering projects needs reliable instruments and tools to achieve highest efficiency levels. It is required specially during tunneling or deep digging which might effect at buildings and objects located in the influence zone causing displacements and cracks. One of the way of controlling the site in this zone is to use manual or mechanical crack meters located at buildings walls [1,2]. This article describes results of tests of a new digital crack meter concept. This new solution based on photogrammetry software and mobile devices hardware enables for precise, fast and reliable measurement of crack wideness. First stage of measurement module tests are presented in this paper.

Keywords: crack monitoring; digital measurement; mobile devices

OPTIMAL EYE FIXATION DETECTION SETTINGS FOR CARTOGRAPHIC PURPOSES

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ABSTRACT

Eye-tracking technology was not fully utilized in the cartography or geosciences yet. With its use, ways of users reading of maps can be revealed, and maps can be optimized. Before eye-tracking evaluation, it is necessary to detect eye-movements like fixations and saccades.

Paper deals with the evaluation of four different settings of the dispersion-based algorithm for optimal fixation detection for evaluation of maps. Data for the case study originated from the cartographic studies, where stimuli displayed the classical orthogonal maps and their 3D (perspective) equivalents.

The paper describes the basics of eye movement recordings, its history and used methods. An emphasis is placed on the remote methods, which uses digital images of the front of the eye. Image recognition methods are used for detecting the position of the eye. From these data, fixations and saccades are calculated. Number of a detection algorithm exists. For the data recorded with a sampling frequency lower than 250Hz, I-DT is mostly used. It is essential to find out the best settings of this algorithm.

In the case study, three existing threshold settings were compared with the new one. Calculated fixations were compared with the plot of raw data, and the most relevant settings were chosen. For eye-movement analysis, it is possible to use software from the manufacturer, but there exist also the open-source alternative. Software OGAMA is fully sufficient for data analyses, but fixation detection thresholds are entered in a different way. Paper also describes the optimal fixation detection settings in this software.

As a result, the fixation detection thresholds for I-DT which represents the recorded data at the best were created. Subsequently, the most corresponding settings were chosen in the open-source software for gaze analyses. The optimal eye fixation detection settings can be used in other cartographic studies using eye-tracking as the main evaluation method.

Keywords: Eye-tracking, Eye-movements, Fixation, Detection, Cartography

PARALLEL ALGORITHMS FOR SOLVING STRUCTURAL INVERSE MAGNETOMETRY PROBLEM ON MULTICORE AND GRAPHIGS PROCESSORS

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ABSTRACT

The most important geophysical problems are inverse gravimetry and magnetometry problems. Among them are the structural gravimetry and magnetometry problems of finding interfaces between layers with different densities or magnetizations using known gravitational or magnetic data [1], [2], [3]. The gravimetry and magnetometry problems are described by nonlinear integral Fredholm equations of the first kind; they are ill-posed problems. After the discretization of integral operators, the problems are reduced to systems of nonlinear equations with dense matrices. The real gravity and magnetic measurements are carried out over a large area producing large-scale grids. Processing of gravity and magnetic data is time consuming and requires a lot of memory.

In this paper, for solving the structural inverse magnetometry problem in a multilayer medium, efficient stable parallel algorithms based on iteratively regularized gradient methods with variable weight factors are proposed. The algorithms were implemented numerically with using new computing technologies on the parallel computing system Uran at the Institute of Mathematics and Mechanics of the UB RAS. The structural magnetometry problem with “quasi-model” data was solved.

Keywords: gravimetry and magnetometry, inverse problems, parallel algorithms, multicore and graphics processors

PRACTICAL APPLICATION OF SATELLITE INDICES TO IDENTIFY URBAN AND PERI-URBAN DEVELOPMENT IN THE MUNICIPALITY OF CLUJ-NAPOCA (ROMANIA)

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ABSTRACT

Remote-sensing based on multi-temporal satellite images has allowed us the mapping of changes in urban and peri-urban areas in order to illustrate the urban development over time. In this article we have used Landsat TM and ETM+ images for a period of time with significant changes in urban structures. On the basis of these images we have calculated a series of indices to differentiate built-up surfaces from the ones covered with vegetation or aquifer surfaces. Thus, we have used NDBI (Normalized Difference Building Index) and IBI (Index Based Built-up Index) indices to identify impervious urban areas, SAVI (Soil-Adjusted Vegetation Index) indices to highlight vegetation-covered areas and MNDWI (Modified Normalized Difference Water Index) indices in the case of aquifers.

The mapped results at accuracy over 90.0% represent a useful method in the study of urban planning. Over time, these modifications have been quantified using spatial analysis. Therefore, we have spotted changes in land use areas and their arrangement in relation to city centre and its limit. The combined use of Remote Sensing and GIS has created valuable tools for making better decisions in urban and environmental planning.

Keywords: remote sensing, built-up areas, satellite indices, urban development, spatial analysis.

PRACTICAL QUESTIONS OF THE METHOD OF INTERPRETATION GEOPHYSICAL SIGNAL AS A VECTOR OF HILBERT SPACE

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ABSTRACT

The contribution builds upon the series of papers by the authors in which the subject of utilization of abstract vector spaces for digital signal processing is dealt with. With the applications the authors are oriented on the field of geotechnology. In this contribution is shown the practical aspect in the choice of one out of several possible interpretations of the process signal as a vector of the space with an inner product. The criterion of the choice of the type of signal space and the method of expressing the signal as a vector of this space is the sufficient stability of the location of the stationary signal in this space. This contribution builds upon previous works of the authors in the area of utilization of abstract Hilbert spaces in control of specific processes. In this paper, some possibilities and aspects of visualization of concurrent vibrations in respect to efficient control of drilling are pointed out. In the contribution are processed some data obtained at the experimental drilling stand of the Slovak Academy of Sciences.

Keywords: rotary drilling, vibrations, Hilbert's space, functional analyses, visualization of vectors

PROGRAM COMPONENTS FOR WEB-ORIENTED GEOINFORMATION SYSTEM OF FOREST FIRE DANGER PREDICTION

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ABSTRACT

The web-oriented geoinformation system for forest fire danger prediction based on a probabilistic fire danger criteria is described in the paper. The new method of the calculation of the probabilistic fire danger criteria is depicted. A new formula for fire danger assessment for a certain time interval of forest fire season is obtained using the basic principles of the probability theory. A definition of the probability using frequency of events is used to calculate fire danger. The statistical data for certain forestry is used to determine all the multipliers in the formula of fire danger.

The geoinformation system for forest fire danger assessment based on the method described here is developed by the Django platform in the programming language Python. The system architecture based on Django's Model-View-Template is described in the paper. The software package that runs on the server allows to get and visualize a set of parameters describing forest fire danger. The GeoDjango framework was used for realization of cartographic functions. A fragment of a forest fire risk map which corresponds to certain value of fire danger is depicted.

The estimation of the fire risk and visualization it on the map help to identify areas most prone to fire ignition and spread and to allocate forest fire fighting resources efficiently.

Keywords: geoinfomation system, forest fire danger, fire danger criteria, fire risk, Django, GeoDjango, Python, Model-View-Template

PSEUDOSTORM EFFECT: COMPUTER MODELLING, CALCULATION AND EXPERIMENT ANALYZES

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ABSTRACT

The paper is concerned with research, computer modeling results and analysis of amplitude-frequency characteristics of geomagnetic pseudostorm effect (GMPS-effect), which appears during any aircraft flight. The gained results are discussed on example of civil airline Boeing 767-300 and its flight AA937 (American Airlines) "New York – Rio de Janeiro".

Keywords: geoinformation systems, geomagnetic variations, geomagnetic pseudostorm, geomagnetic field

RIVER NETWORK RECONSTRUCTION AND ANALYSES IN AREAS AFFECTED BY HEAVY INDUSTRY

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ABSTRACT

Heavy industry, open-pit mining and other types of intensive human activity are affecting the surrounding landscape in many ways. The intensive mining followed by industrialization is changing the environment in large areas. It affects the global structure of the area influencing the land-use, georelief shape, settlement distribution and hydrological network structure. In this article we focus on the hydrological network reconstruction as the knowledge of the original network is important for further development of the region. The methodology is introduced on study area situated in the North-West part of the Czech Republic in the brown coal basin near the town Most. The hydrological network reconstruction is performed using the old maps of the area of interest. The old maps were selected with respect to scale and stage of landscape/industry development. The oldest used maps are the maps of the 2nd Military Survey of Habsburg Empire (ca. 1846) where is described the natural development of the contemporary agricultural land. Maps of the 3rd Military Survey of Habsburg Empire reambulated in 1938 are introducing the agricultural land being transformed into industrial landscape with chemical industry and open-pit mining. The current data are showing the industrial landscape with reclamations (former open-pit mines turned into forest, lakes, etc.) and heavy modified hydrological network. Several methods for river-network development analysis are introduced including sinuosity analysis, displacement analysis, etc.

Keywords: hydrological network, reconstruction, analysis, mining, North-West Bohemia.

SCENARIO-BASED SIMULATIONS WITHIN THE SYSTEM OF COUPLED URBAN MODELS

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ABSTRACT

The spectrum of possible scenarios that happen within an urban areas ranges from micro-level interactions between the citizens to the large-scale processes, such as flooding, fire, traffic jam and urban development. Since micro- and macro-levels of the city environment are inevitably interconnected, the integrated system that couples models of different scales with data and visualization facilities is a subject of interest for modern urban planners. Present work proposes a description of such system together with selection of scenarios that was developed within it. System is supporting by data aggregation and visualization tools and includes agent-based society model and urban-planning model.

Keywords: urban modelling, scenario-based simulations, flood, multi-agent simulation

SETTLEMENT IDENTIFICATION IN ABANDONED BORDERLAND

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ABSTRACT

Settlement extinction is a very common phenomenon in the borderlands of the North-West part of the Czech Republic. After the 2nd World War were almost all the German inhabitants moved from the borderlands to Germany. Almost all of the former settlement has disappeared as it was never again inhabited. A very significant example presented in this paper is the former village Jilmová (in German Ulmbach). The task of this project is to perform settlement development analysis on both sides of the border, land-use change analysis within the cadaster Jilmová and to identify the settlement residuals in the field. The settlement residual identification was performed by several methods – identification using the old maps, high precision LIDAR scanning, GNSS field survey, Kite Aerial Photography (KAP) and Unmanned Aerial Vehicle (UAV). All the processed data are available as a web-mapping application using the ArcGIS API for Flex offering the project results to the wide public use.

Keywords: settlement identification, borderland, old maps, UAV, DTM.

SMART HOUSING ESTATE: MULTIDISCIPLINARY DATA FOR ENVIRONMENTAL MODELLING

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ABSTRACT

Nowadays, the authorities put a strong emphasis on energy reduction in the housing sector as well as a usage of green technologies according to European Union energy strategy based on Directive 2010/31/EU on the energy performance. This paper describes multidisciplinary data integration in the existing housing estate, within the pilot project in the city district Nový Lískovec in Brno.

In studied area, multiple data integration is based on a geodatabase and 3D spatial model combined with data from building monitoring and aerial and terrestrial thermography. Furthermore, multidisciplinary data are applied by experts in various simulations. Their results subsequently serve as additional input for final multidisciplinary information model (MIM).

Close cooperation among various experts can improve and upgrade the whole process of environmental modelling. Standard data sets are transformed into one multidisciplinary data set with effectiveness, collision avoidance and easy data transfer.

The created model of multidisciplinary data should seek to improve decision-making processes in the context of sustainable development of the settlements and the region.

Decision-making strategies in GIS analytical tools enable sustainable development and competitiveness of regions based on the solid knowledge and objective information which is in line with the European Union energy strategy.

Keywords: housing estate, 3D city model, environmental analyses, GIS, multidisciplinary data, CityGML

SPATIAL ANALYSES OF TWITTER DATA – CASE STUDIES

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ABSTRACT

Nowadays, thanks to integration of information and communication technologies to everyday life, huge volumes of information generated by different kinds of subjects emerge. This information might be a valuable source for decision support in many domains of business, political and personal spatial activities. One of such sources is microblog system or social network with enabling blogging, i.e. sharing short text messages by the users of these systems (such as Twitter). During the analysis of the collected Twitter data via Twitter API the text messages were processed and also supplementary information including actors' characteristics, place and data of the origin of the message etc. were analysed.

In the presented case studies, text data from social network Twitter were processed, analysed and visualized. Individual posts have associated, besides other things, geographical coordinates and they can be thus attached to a certain place on the Earth. Spatial analyses with application in many domains might be therefore applied to the data. The first case study focused on analysis of customer behaviour in the field of alcoholic beverages consumption around the end of the year 2013 in the Czech Republic. The second case study focused on geopolitical events on-going in Ukraine these days (spring 2014) and on related geolocated tweets about these events. Both case studies were performed using spatial analyses tools in GIS as well as cartographically visualized on a map.

Keywords: Spatial Analysis, Social Networks, GIS, Twitter, Visualization, Ukraine

SPATIAL DYNAMIC OF SOME LACUSTRINE SALTY AREAS USING TOPOGRAPHIC AND GPS SURVEYS AND GIS ANALYSIS IN TRANSYLVANIA, ROMANIA – CASE STUDY

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ABSTRACT

Using modern techniques in both topography and global positioning, along with data processing in adequate GIS mapping software, there were identified a particularly great spatial and temporal dynamic of the ancient salt exploitation areas in Transylvania. The appearance or disappearance of some anthroposaline or karstosaline lacustrine units happens frequently and it is specific to diapiric structures in regions with former salt mines. In Ocna Şugatag (Maramureş County) we have observed the disappearance of some karstosaline lakes and the spatial development of anthroposaline lakes. On the other hand, in the case of Ocna Mureş (Alba County), there was a remarkable evolution because we have found the largest anthroposaline lake in Romania, which appeared out of the junction of more than two individual lakes. In both cases, the accelerated dynamic of lacustrine areas has been determined by the persistence of salt dissolution processes and established by comparing old cartographic representations with the latest data obtained using GPS and topographic surveys. The analysis and interpretation of spatial data and data attributes made possible the design of integrator drawings for both studied areas with the following elements: location of old exploitation mines, outlines of ancient and existing lacustrine units, dwellings in the sensitive areas of old exploitations etc. On the basis of these elements we have considered important the establishment of vulnerable areas for localities situated near the lakes and terrains covering the exploitation chambers. Taking into consideration these aspects we believe that it is required an intensification of research and monitoring of the areas with high levels of risks.

Keywords: dynamic, salt lake, topography, GIS, vulnerability.

SPATIAL MODEL OF THE VILLAGE TO SUPPORT THE MANAGEMENT OF PUBLIC ADMINISTRATION

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ABSTRACT

The village is the basic territorial self-governing and an administrative unit of the Slovak Republic. Each municipality is governed by legislative regulations. The role of a municipality is to take care of its territory and the needs its of population. The village administration as a public authority is an operator of information systems and provides various types of descriptive and spatial information for its citizens. Development of municipalities and micro-regions is increasingly based on the use and visualization of spatial databases. Currently there is a growing demand from municipalities for spatial reference data, which could help make their administration more effective. The aim of this paper is the design of a spatial model of the village for purposes of geoinformation support of public administration.

Keywords: village, public administration, legislation, spatial data, conceptual model

STABILITY OF THE LEVEES IN CASE OF HIGH LEVEL OF THE WATER

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ABSTRACT

In this work we present preliminary results of two-dimensional dynamic modeling of the levee stability in case of high level of the water. Performed calculations are the part of the ISMOP project whose objectives span construction of an artificial levee, design of wireless sensors for levee instrumentation, development of a sensor communication infrastructure, and a software platform for execution management, data management and decision support. The aim of our work is to prepare a wide variety of simulation scenarios for different values of geotechnical parameters and different initial conditions. These scenarios will be used to developed a software platform in ISMOP project.

In this paper we focused on influence of different initial conditions on the stability of levees and distribution of such parameters as stress, strain, displacement in the levees and their neighborhood.

Keywords: levee stability, 2D numerical modeling

STUDY ON THE IMPLEMENTATION OF GIS DATABASES IN ACHIEVING THE GENERAL URBAN PLAN

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ABSTRACT

The paper purpose is the presentation on the first part of some general data concerning GIS technology and its role in urbanism and real estate advertising projects. Also, in the next place are presented which are the advantages and disadvantages of this new technology utilization in mentioned projects, and way of realization and implementation of a new GIS master schedule. Finally are described which are the objectives to be achieved on the level of Bistret commune, the GIS layers used in General Urban Plan (PUG), and the concrete followed steps for generation of an Urbanism Certificate.

Keywords: GIS, PUG, map, plan, topo-surveyng details

SURVEYING AND ANALYSIS OF THE LANDSLIDES USING UAS REMOTE SENSING

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ABSTRACT

Geodetic measurements and monitoring are traditional methods of the observation of landslides, and slope movements processes in general. The precision of measurements is usually an important task, as well as the expended amount of time and money are important. It is not necessary to reach sub-centimetre precision in case of the regular monitoring of shallow landslide due to the effort to the evaluation of the whole landslide body. Unmanned aerial systems provide the great improvement in the efficiency of the process, and they also broaden possibilities in the visualization while the accuracy is still preserved on the suitable level.

The contribution aims to present the current observation of shallow landslide, which has been monitored for seven years using geodetic measurements. Recently, the conventional surveying activities are complemented by the photogrammetric methods (Drone Pixy or Hexacopter). They allow monitoring of the slope stability and precise evaluation of the general shape of the landslide body including a volumetric analysis.

Keywords: Unmanned aerial vehicles, geodetic surveying, accuracy preservation, slope movement processes, photogrammetric evaluation.

THE GENERATION ALGORITHM OF SPATIAL OBJECTS FOR CITY INFRASTRUCTURE BASED ON TOPOLOGICAL RELATIONS BETWEEN LAYERS

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ABSTRACT

The city infrastructure objects are complex spatial data. Spatial datasets are used for the simulation of various situations in the urban environment, for example, in emergency cases or analysis of traffic. To solve these tasks we can apply ready-made maps. But if some task requires additional layers of the map then the generation process of the spatial location of objects is important. The algorithm of generation between spatial objects must ensure topological consistency. The developed algorithm analyzes the spatial arrangement of the objects in the generation of new layers, using additional information about the topology between layers. Topologically independent objects are generated in the first place. The order of formation of following layers uses topological sorting. All information about topology is stored in the database. This algorithm allows to create models of urban infrastructure with topologically correct location and can be used to generate complex city maps.

Keywords: topological relationships, automatic generation of objects, topological sort of layers

THE LADM AS A CORE FOR DEVELOPING THREE-DIMENSIONAL CADASTRAL DATA MODEL FOR POLAND

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ABSTRACT

The main objective of the paper is to develop a conceptual model of three-dimensional cadastral system for Poland, by applying the International Standard ISO 19152.

In order to create transparency in understanding real needs for 3D cadastre in Poland, the rules concerning current registration of spatial objects are examined and illustrated with appropriate case studies. The investigations reveal that Polish cadastral system meets serious complications with providing information about the legal status of real properties in case of 3D complex situations.

As a consequence, the proposals of the Polish LADM country profile extensions are introduced. It is decided that a hybrid cadastre supporting coexistence of 2D and 3D cadastral objects will be the most convenient solution. New spatial representations of cadastral objects are proposed. In connection with the fact that Annex E of the ISO 19152 distinguishes only 2D or 3D spatial profiles, the paper presents the first integrated 2D/3D spatial profile which is a state-of-the-art proposal constituting interesting scientific contribution in the international context.

Keywords: 3D cadastre, conceptual modeling, LADM, spatial profile

THE MOVABLE HERITAGE KNOWLEDGE BASE: A CASE STUDY ON WORKS OF ART FROM THE CHURCH IN ZORAWINA

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ABSTRACT

Movable heritage is this kind of heritage, which can be easily moved from one place to another. As a result movable monuments can provide information not only about themselves, but also about other monuments - movable or immovable - related to them in the past as well as about past places, phenomenon and events.

The aim of the research is to develop the concept of knowledge base and semantic integration of different heterogeneous data sources in the area of movable heritage. The paper presents the CIDOC CRM and OWL ontology model of works of art from the Holy Trinity Church in Zorawina (Poland) and immovable monuments related to these works and the methodology of mapping the ObjectID metadata elements into the CIDOC CRM ontology. The geospatial semantics issues on identifying names of places and spatial relationships are also discussed.

The one hundred of analysed monuments represent almost all artistic periods - from Gothic to Modernism. They were originally made as an accessory of the church, but now most of the objects are dispersed and held in various museums and churches - mainly in the Silesia area, but also in the whole territory of Poland. Some of works of art are separated from their original collections or objects (e.g. parts of the altar) and stored in different places or exist as independent monuments.

Keywords: knowledge base, movable heritage, works of art, ontology, ontology modelling

THE NEED FOR SPATIAL ANALYSIS IN HANDLING CONTAMINATION ENVIRONMENTAL RESOURCES AND HUMAN HEALTH IN TERMS OF SIMPLICITY AND COMPLEXITY

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ABSTRACT

It is well known that any human being without air survives a few moments, without water a few hours and no more than a few days without food. In spite of these facts never a fair study has cover or shown the effects of the bad quality of these three parameters. Air pollution, water contamination or bad food quality are not cute lethal factors but no one knows or has proven in reality how they affect in the long run, not alone but in any combination and even more the influence of one to another. Perhaps the complexity of the case makes such a study extremely difficult, therefore prohibitive and selectively or by necessity is driven to simplicity. On the other hand simplicity is somehow what people, investors/big or small companies and even government officials prefer to know. The arising/immediate question is whether the research serve the specific purposes of its funders or protect them against any kind of questionable or self-seeker results. In this report we refer in some examples of simplicity in research cases and try to implement the necessity of complexity because nowadays research results cannot be given only as lifeless numbers in tables or graphs. Conclusions and suggestions as results, especially in environmental aspects related to society, are either difficult or "dangerous". We believe that research and especially Academic ought to protect society on the first and secondly give to companies and especially to the government officials the correct and exact (if possible) information and "icon", in other words ring the bell of information/knowledge in order to hear.

Keywords: Complexity, Simplicity, Social Geoinformatics, Spatial Analysis

THE USE OF 3D IMMERSIVE VIRTUAL REALITY FOR VISUALIZATION OF LANDSCAPE AFFECTED BY OPENCAST MINING

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ABSTRACT

The use of geospatial visual displays – geovisualization is recognized as a useful way how to explore, analyze and present geospatial data. Integration of geographical information systems and virtual reality find its use in various fields from decision making processes to education. The reconstruction of devastated landscapes and its visualization through immersive and interactive virtual reality applied for educative purposes can produce alternative view and new insight in local landscape history and help to facilitate the extent of the changes. Our objective was to visualize the fundamental landscape change near Chomutov town (Czech Republic), influenced by open-pit mining in 1960s. For the purposes of landscape reconstruction, digital terrain models (DTM) and DTM analysis based on data from Derived State map (1 : 5000, 1953) and Lidar data (2010) were used. Both models were visualized through Virtual Reality Modeling Language (vrml).

Keywords: Geovisualization, virtual reality, landscape change, Chomutov

TIME-SPACE VISUALISATION OF AMUR RIVER CHANNEL CHANGES DUE TO FLOODING DISASTER

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ABSTRACT

The analysis of flooding levels is a highly complex temporal and spatial assessment task that involves estimation of distances between references in geographical space as well as estimations of instances along the time-line that coincide with given spatial locations. This work has an aim to interactively explore changes of Amur River boundaries caused by the severe flooding in September 2013. In our analysis of river bank changes we use satellite imagery (Landsat 7) to extract parts belonging to Amur River. We use imagery from that covers time interval July 2003 until February 2014. Image data is pre-processed using low level image processing techniques prior to visualization. Pre-processing has a purpose to extract information about the boundaries of the river, and to transform it into a vectorized format, suitable as inputs subsequent visualization. We develop visualization tools to explore the spatial and temporal relationship in the change of river banks. In particular the visualization shall allow for exploring specific geographic locations and their proximity to the river/floods at arbitrary times. We propose a time space visualization that emanates from edge detection, morphological operations and boundary statistics on Landsat 2D imagery in order to extract the borders of Amur River. For the visualization we use the time-space-cube metaphor. It is based on a 3D rectilinear context, where the 2D geographical coordinate system is extended with a time-axis pointing along the 3rd Cartesian axis. Such visualization facilitates analysis of the channel shape of Amur River and thus enabling for a conclusion regarding the defined problem. As a result we demonstrate our time-space visualization for river Amur and using some amount of geographical point data as a reference we suggest an adequate method of interpolation or imputation that can be employed to estimate value at a given location and time.

Keywords: boundary, river channel, visualization, time-space-cube, point reference data

TOWARDS A FRAMEWORK FOR SIMULATION-BASED EVALUATION OF PERSONAL DECISION SUPPORT SYSTEMS FOR FLOOD EVACUATION

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ABSTRACT

Development of personal decision support systems for emergency evacuation is a complex task which requires a simulation-based evaluation to be conducted. For this purpose a composite geo-simulation application for the case of flood threat is developed on the base of an agent-based simulation framework. The application is composed of a traffic dynamics model coupled to a flood model and is used as a framework for investigation of the efficiency of three in-vehicle spatial personal decision support systems. These navigation systems are based on different approaches to the management of environmental dynamics information.

Keywords: agent-based modeling, evacuation simulation, traffic simulation, flood model, decision support system

TRAFFIC INTENSITY CHANGES AND THEIR INFLUENCE ON SPATIAL DISTRIBUTION OF SUBURBANIZATION

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ABSTRACT

The paper deals with an increase of car traffic intensity within the area of the city of Olomouc and its neighbourhoods. The aim of the research was a temporal analysis of traffic volumes and the resulting changes compared with the spatial differentiation of suburbanization in the hinterland of the city of Olomouc. Input datasets were data traffic volumes of traffic censuses in 2000 and 2005 and field research of authors in 2010.

Keywords: traffic intensity, temporal analysis, suburbanization.

TWO ACCESS DATABASES ORGANIZATION FOR SASA LEAD-ZINC DEPOSIT AND TAILINGS, REPUBLIC OF MACEDONIA

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ABSTRACT

Within the Republic of Macedonia there are numerous polymetallic mineral deposits important for its economy. This paper focuses on efforts we made to organize Microsoft Access database with the most representative data for the most important Pb-Zn deposit in the Republic of Macedonia, the Sasa deposit and mine near the city of Makedonska Kamenica. First of all, with the software package "Microsoft Access" we have organized database with information of the most important geological, metallogenic and economic features of the deposit. Also, we have not omitted the fact that each active mine exploitation has been followed with production of significant anthropogenic input to the environment, so we have structured and anthropogenic database too. Both databases were adapted for simple and sophisticated querying of particular deposit and anthropogenic features and allows edition of reports and a geographic display of the queried information.

Keywords: mineral deposit, Access database, reserves, anthropogenic concentrations.

USE OF GEOGRAPHIC INFORMATION SYSTEMS FOR ASSESSMENT OF GROUNDWATER QUALITY IN INDUSTRIAL HUBS

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ABSTRACT

The article describes an approach to constructing concentrations fields of elements in ground water on the example of Tambov industrial hub using geographic information system ArcGIS.

Keywords: GIS technology, geochemical analysis, ground water, industrial hub

VECTOR MAP OBJECT RECOGNITION BASED ON A HIERARCHY OF TOPOLOGICAL RELATIONSHIPS

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ABSTRACT

The input of information in the municipal geographical systems is a complex iterative process. There are many different sources of map. The most common is currently the manual digitizing of maps. But it is a very expensive process especially for city objects. For quick information input, we can use the photo decoding of aerospace images. The algorithm for the realization of this process was developed. It consists of two stages. At the first stage we get a vector objects on a raster map. In the second phase the vector objects are classified. A hierarchical tree is built where each level involves checking of the topological features of the object together with other objects. The lower level of the tree defines a specific layer which includes the analyzed object. This algorithm allows to obtain multi-layer digital map of the city by recognition vector spatial objects of map.

Keywords: topological relationships, spatial objects recognition, vector map

VIBROSEISMOACOUSTIC METHOD IN STUDYING OF GEOPHYSICAL FIELDS INTERACTION IN GROUND ATMOSPHERE

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ABSTRACT

This paper presents the results of experimental investigations of the original ecologically safe approach as related to the assessment of the geoecological risk from powerful mass explosions for the social and natural environment. In this approach, seismic vibrators are used as sources imitating explosions but having, in contrast to them, a much smaller power. Such sources can simultaneously excite in a medium seismic and acoustic (vibroseismoacoustic) oscillations with precision power and frequency-temporal characteristics
Keywords: technogenic and natural explosions, acousto-seismic fields, geoecological risk, the seismic vibrator, geologo-meteo conditions.