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Modeling bicycle traffic volume for the city of Zagreb based on multiparameter geovisual analytics of crowdsourced spatial data

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The bicycle as a means of transport is a healthy, economical, and environmentally friendly alternative to motorized traffic. In the age of the coronavirus pandemic it is gaining in importance in urban areas. To make reliable decisions related to planning of bicycle infrastructure and to increase the safety of non-motorized traffic, it is necessary to have at least bicycle ridership data for key locations of the traffic network. Manual counting of bicycle traffic is time consuming and does not provide sufficient temporal and spatial detail. Permanent traffic counters provide temporal detail, but do not have spatial coverage or other information about cyclists passing by. In contrast, crowdsourcing allows cyclists to track their activity without a time limit at any location using GPS enabled mobile phones. The only requirement is to use a specific app, such as Strava. Generally, such data represent a small share in total bicycle counts and can therefore lead to results in favour of a certain group of interested participants. Nevertheless, the amount and spatio-temporal resolution of crowdsourced data provide the possibility for a better and more accurate modeling of bicycle traffic volume.

Several parameters can affect the amount of bicycle traffic such as bicycle infrastructure, environment, weather conditions, time of year, terrain slope, demographic structure of the population and motor vehicle traffic. These parameters vary depending on the location and culture and can significantly affect the result of bicycle volume modeling. The emergence of the coronavirus has also significantly contributed to the growth of bicycle traffic and investment in new infrastructure across European cities. In this research, the influence of individual parameters in combination with crowdsourced data will be examined with the help of geovisual analytics. As a result, a bicycle traffic volume model will be made for the area of the city of Zagreb. Since the city of Zagreb does not have data on cycling activity, the developed model should be the basis to better understand the current as well as predict future bicycle traffic. It should also help traffic planners for planning new bike paths that are more than necessary.

Abstract

Galactic cosmic rays (GCR) consist of high-energy particles that originate far outside solar system and reach the Earth. Studies show that for every decrease in GCR intensity there is an increase in interplanetary magnetic field (IMF). Interplanetary magnetic field can be increased due to different phenomena in solar atmosphere, such as coronal mass ejections (CMEs) – phenomena driven by the energy released from magnetic field. Furthermore, for every increase in IMF there is a decrease in GCR intensity. The objecitve of this paper is to show how the shock wave caused by CME affect the test particle. We approximate the shock by a structure where the magnetic field linearly changes with position within this structure. We assume protons of different energy, different pitch angle and different incoming direction. We also vary the shock parameters such as the magnetic field strength and orientation, as well as the shock thickness.

Review of machine learning algorithms for urban land use planning

Abstract

Urbanization is a universal phenomenon which has its consequences and it is especially challenging in developing countries with the increasing rural to urban migration resulting in immense pressure on the limited resources, impacting the physical environment. Traditioanl analytical methods of studying the urban land use dynamics which are static and top down appraoches such as linear and mathematical modeling do not capture the non linear properties of land use change. The new technologies like Artifiical inteligence (AI) and machine learning (ML) have made it possible to study the non linear aspects of urban land dynamics. The use of AI and ML is based primarily to optimize, streamline and increase the reach of different operations in managing and administering urban centres. AI and ML are programmed to recognize patterns and carry out predictions, decision making and perform operations with speed and accuracy. Classification, analysis and modeling using earth observation based data forms the basis for the geospatial support for land use planning. In the process of achieving higher accuracies in the classification of spatial data, ML algorithms are being developed and being improved to enhance decision making processes. There are a number of machine learning algorithms for processing earth observation data (EO). These algorithms satisy different objectives such as transition in land cover classes, GANs (Generative Adversial networks) which has been used to simulate urban patterns. Random forest (RF) classifier has been used for image classification with high accuracies, deep learning like convolutional Neural network (CNN) and Support Vector machine (SVM) and for simulation modeling like urban growth, land use change, settlement pattern analysis models like cellular automata, Spatial logistic regression and agent based modeling have been applied for studying aspects of land use planning. Advanced ML algorithms can handle high dimensional data which was not possible in the traditional classification algorithms since it posed statistical challenges. The paper intends to make a review of the currently used machine learning algorithms in urban land use planning, how do they work, what are the functional requirements, interoperability requirements and for which research problems can they be applied best.

Development of a Novel Methodology for Vegetation Mapping using Radar Satellite Imagery

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Abstract

Depending on the source of the electromagnetic radiation, remote sensing sensors, which measure existing radiation, can be distinguished as active and passive sensors. Passive sensors rely on the illumination of the Earth by the sun and measure the reflected radiation from a Earth surface. Optical image quality can be seriously affected by atmospheric conditions. Active sensors provide illumination by sending out microwaves and are mostly cloud independent. A radar system sends pulses of microwaves towards the Earth and records the intensity of the returned echoes for each pixel. Radar systems, such as synthetic aperture radar (SAR) and LiDAR are examples of active sensors. Due to the processing complexity of SAR data, their usage for land-cover mapping has not been well-researched. In order to increase the classification accuracy, different preprocessing methods of single-date and multitemporal SAR imagery will be researched. The research will be conducted in urban areas of cities across Europe using Sentinel imagery. In addition to the evaluation of various preprocessing steps for SAR imagery and number of input features on classification accuracy, performance of various machine learning methods will also be evaluated.

High temporal resolution of synthetic aperture radar (SAR) imagery, such as that of Sentinel-1 (S1) imagery, creates new possibilities for generating land-cover classification (LCC) maps. SAR systems offer a possibility of acquiring data in a continuous manner, regardless of the weather and lighting conditions, which enables rapid mapping of environmental changes. However, compared to the optical satellite data, there are several challenges regarding SAR image analysis for land-cover (LC) applications (e.g., speckle, radar shadow caused by layover, and foreshortening). Additionally, due to the complex pre-processing and interpretation of radar data, numerous researchers still use optical satellite data for LC mapping. Furthermore, using multitemporal imagery for LCC, number of input features is rapidly increasing. This research will use supervised methods for feature selection in order to develop a system for determining the optimal number of input features for LC classification.

Keywords: land-cover classification; machine learning; Sentinel-1; synthetic aperture radar (SAR), vegetation mapping.

Developing a model for improvement of the metadata availability on the cadastre establishment

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Abstract:

Cadastre establishment is conditioned by historic, law and cultural framework in each country. The exposure of the teritory of Republic of Croatia to the influences of various countries has resulted in three period of cadastre establishment: Franciscan, Yugoslavian and Croatian cadastre. Franciscan cadastre was established in 19th century by systematic approach for all teritory of today Republic of Croatia. In Yugoslavian cadastre about 25% of the Croatian area was renewed by cadastral surveys. The research are was chosen to include all relevant types of spatial units for the subject research (more cadastral municipalities, offices).

The cadastral documentation occured by establishment of cadastre is different by content, quality and structure between thoose three periods and it is mostly stored in state archives in Zagreb, Split, Trieste and Glina. Archival documentation stored in the state archive will be used for the research. Archival data in Trst will be accesed through web service.

Today, in most European countries, the cadastral map is available in electronic form. In Croatia, all cadastral data have been available electronically since 2016. Although availability and using of cadastral data become faster and easier, many usefull informations from analog documentation are unavailable on representations derived from the electronic cadastral map. Metadata, which were in description list of analog data, in most cases are not visible. Most of historical states and elements of quality are unavailable. It is extremely important to make information about the quality of data obtained available to data users. Metadata which is dealt with by several insitutions, organisations and associations at the international, regional nad national level, provides help in this. The way in which metadata is defined and grouped is determined by the appropriate schema and the corresponding metadata dictionary, which is defined in the used standard. A number of metadata standards have been developed worldwide, the most important ones are: FGDC Content Standard for Digital Geospatial Metadata (CSDGM), ISO 19115 Geographic Information – Metadata, ANZLIC Metadata Guidelines, Dublin Core Metadata Initiative (DCMI), INSPIRE Metadata Regulation.

Existing metadata standards poorly support the cadastre area and cannot be directly implemented for cadastral data. They were developed primarily for the needs of cartography and generally they don't contain human relations regarding land which is the primary content of the cadastre. Therefore, posibility of upgrading them will be explored. The research will first analyse and identify the processes within the cadastre establishment project, as well as key metadata from official and archived cadastre documents. The structure and content of documents in three periods of cadastre establishment in the territory of the Republic of Croatia will be analyzed.

Then the metadata standards will be studied and their applicability for the area of cadastre, regarding its establishment, will be examined. The most appropriate international standard will be selected, whose metadata elements will be compared with the elements identified from the collected documentation. Suggestions will be made to improve the standards to support the land administration system data.

Development of framework for monitoring of land administration systems by applying methods of complex system science

Abstract:

Land governance is about the policies, processes and institutions by which land, property and natural resources are managed. Each state establishes its land governance system depending on cultural heritage, social system, economic development and technological availability. As such, it has direct impact on competitiveness of national economy while is indirectly influencing functioning of whole society. Main components that support functioning of land governance are land administration systems which are based on registers.

Land administration systems and cadastral systems as their key components are continuously evolving as a result of new social needs and the relationship that society has with land. Many existing systems are products of the economic and land paradigms of the 19th century and they have failed to properly support sustainable development. In response to this situation, traditional cadastres are evolving into comprehensive systems that address broader issues than location and interests on land.

Many developed countries, but also developing ones, recognize the need to assess cadastral systems to help identify areas for improvement, how their systems adapt to respond to future needs. Countries are continuously rearranging and conducting activities in different segments of the cadastre, evaluating and comparing systems and trying to identify the best practices of a nation of similar socio-economic status.

For the system to be efficient, it needs to be continuously optimized. Effective system optimization involves the improvement of critical system components which is impossible without clearly formulating the desired state, or the goal of a system.

While the original purpose of cadastres was essential and useful in facilitating simple land trading to support expanding economies, and modern land markets with their complex commodities offer potential opportunities to take another leap forward, it is the land information derived from the LAS that has the potential to transform the way modern societies function. Hence, a vision of a modern land administration system is spatially enabling governments by providing the "where" for all government decisions, polices and implementation strategies.

A large number of independent rational factors such as public administrative organizations, registers, the geodetic private sector and citizens have a role in achieving this vision. A system consisting of many parts whose action / behavior is highly variable and strongly dependent on the action of other parts is the definition of a complex system. Looking at them from this perspective, land administration systems can be seen as complex systems.

In the context of complex adaptive systems, people are agents operating within larger social, economic, institutional and organizational contexts which limits individual

options and their decisions. An important role of policy is to improve these processes at the macro level in order to create opportunities for individuals and enable better individual decision-making. On the other hand, while the actions and interactions of agents are the main forces shaping the state of complex systems, individual decisions and actions do not necessarily result in results that are optimal for the overall system (Tian, 2017). Therefore, important role of policies is the establishment of social rules (e.g. legal acts, smart incentives) to influence individual decisions and initiate individual actions that would collectively lead to the desired results at the level of the overall (complex) system.

Current trends in scientific research as well as modern technologies have enabled new perspective on realization of complex socio-technical systems. Application of complex system's scientific methods helps in better understanding of land administration systems as key componentes in land governance. Establishment of framework for land administration systems monitoring would enable a scientific support for policy creation in the land administration sector.

The scientific contribution to the improvement of the land management system so far is mainly focused on technical solutions for the improvement of the existing components and processes of the system, while little attention has been paid to understanding the functioning of the entire system.

In theoretical terms, the expected scientific contribution of the proposed scientific research is to look at the functioning of the entire system from a new perspective by applying scientific methods of complex systems.

In the application sense, it is the construction of a model of land management system based on numerical indicators and algorithms that would indicate trends and the expected direction of development of the system.

Development of a new method for processing data of photogrammetric survey by unmanned aerial vehicles to determine landslide displacement

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Abstract: Landslides represent potential dangers that can cause huge economic and human losses. To prevent these catastrophes, it is necessary to monitor landslide displacement over time. Nowadays, due to their advantages, for the monitoring landslide displacements it is frequently applied photogrammetric survey by unmanned aerial vehicles, where displacements are determined by comparing 3D point clouds, digital terrain models, and digital orthophoto models in two measurement epochs. Their creation is obtained by using the „Multi View Stereo" algorithm which is the most demanding and takes the most processing time in the joint processing of entire „Structure from Motion" and „Multi View Stereo" process. As part of the doctoral thesis, a new data processing method for calculate landslide displacement will be development. This new developed method will be calculate displacements from data which were collected by photogrammetric survey by unmanned aerial vehicle and it will be based on the steps of the "Structure from Motion" algorithm without the use of "Multi View Stereo" algorithm, which will significantly shorten the processing time. In conclusion, the accuracy of calculated landslide displacements by new developed method will be determinate by comparison with the displacements determined by classical geodetic survey methods and digital orthophoto models.

Keywords: Landslide, Monitoring, Unmanned Aerial Vehicles (UAV), Structure from motion (SFM), Point Cloud, Digital orthophoto model (DEM), Method

A new approach of military topographic maps production supported by the national spatial data infrastructure

Abstract :

Throughout history, military geographical institutes have been the backbone for development of cartographic activity. Today, with the development of society, IT technologies and network global connectivity, this concept is changing, the collection of geospatial data inflitrate into all activities of society. At the same time, there is a transformation of military organization and strategic interests. The system is increasingly open to other institutions following modern trends and technological developments. In 2009, the Republic of Croatia became a member of NATO and committed itself to interoperability with member states. In these circumstances, military cartographic activity with a centralized system of its own topographic database becomes difficult to maintain and there is a need for a new approach of topographic maps production. The paper will present the method of mapping official sources and geospatial databases of the National Spatial Data Infrastructure (NIPP) into the model of the military project of global mapping Multinational geospatial co-production program (MGCP) in which the Republic of Croatia participates since 2013. NIPP geospatial data are considered as a good basis for modeling because, according to the latest NIPP Council reports, 80% of data belong to the group of highly valuable data sets. MGCP digital vector geospatial databases currently represent the largest verified geospatial databases in the world. The compatibility of these data with the national geospatial data of the members is the main goal of the MGCP program. By creating a framework, they are working on transformational solutions. In addition, MGCP program is supported by the world's leading GIS software producers (Esri and Hexagon) who offer technical solutions and tools for transformations within Arc GIS platform. As a member, Croatia has access to these solutions that could be used for mapping NIPP data into the MGCP model. The mapped data further provides the basis for standardized NATO 1:50 000 scale map production using the MGCP Topographic Map (MTM) standard and the Esri ArcMap 10.5 Rapid Graphic process. With this approach of military maps production, the OSRH obtains the necessary geospatial bases for the level of strategic planning, ensures the set requirements for up-to-date geospatial data and the necessary interoperability as a member of NATO.

Keywords: *military cartography, up-to-date topographic maps, MGCP model, NIPP data*

Novi pristup izrade vojne topografske karte podržan nacionalnom infrastrukturom prostornih podataka

Sažetak :

Kroz povijest vojni geografski instituti bili su okosnica razvoja kartografske djelatnosti. Danas, razvojem društva, IT–tehnologija i mrežnog globalnog povezivanja, ovaj koncept se mijenja, prikupljanje geoprostornih podataka prodire u sve djelatnosti društva. U isto vrijeme dolazi do transformacije vojnih struktura i strateških interesa. Sustav se sve više otvara prema drugim institucijama prateći suvremene trendove i razvoj tehnologije. Godine 2009. Republika Hrvatska postaje članicom NATO saveza te se obavezuje na interoperabilnost s državama članicama saveza. U ovim okvirima, vojna kartografska djelatnost sa centraliziranim sustavom vlastite baze topografskih podataka postaje teško održiva i pojavljuje se potreba za novim pristupom izrade topografskih karata. U radu će biti prikazana metoda mapiranja službenih izvora i baza geoprostornih podataka *Nacionalne infrastrukture prostornih podataka* (NIPP) u model vojnog projekta globalnog kartiranja *Multinational geospatial co-production program* (MGCP) u kojem Republika Hrvatska kao članica sudjeluje od 2013. godine. Podatci NIPP-a smatraju se dobrom osnovom za modeliranje jer se prema zadnjim izvještajima Vijeća NIPP-a 80% podataka ubrajaju u skupinu visoko vrijednih skupova podataka. MGCP baze digitalnih vektorskih geoprostornih podataka trenutno predstavljaju najveće verificirane baze geoprostornih podataka u svijetu. Kompatibilnost tih podataka s nacionalnim podatcima članica glavni je cilj MGCP programa. Izradom frameworka radi se na transformacijskim rješenjima. Osim toga MGCP je podržan od strane vodećih svjetskih proizvođača GIS softwarea (Esri i Hexagon) koji za transformacije nude tehnička rješenja i alate unutar Arc GIS platforme. Hrvatska kao članica ima pristup takvim rješenjima koji bi se mogli upotrijebiti i za mapiranje NIPP podataka u MGCP model. Mapirani podatci dalje daju osnovu za izradu standardizirane NATO karte mjerila 1:50 000 korištenjem MGCP Topographic Map (MTM) kartografskog standarda i Esri ArcMap 10.5 Rapid Graphic procesa. Ovakvim pristupom izrade vojnih karata OSRH dobiva potrebne geoprostorne podloge za razinu strateškog planiranja, osigurava postavljene zahtjeve ažurnosti geoprostornih podataka te neophodnu interoprabilnost kao članica NATO saveza.

Ključne riječi : *vojna kartografija, ažurnost topografskih karata, MGCP model, NIPP podatci*

Model for investment potential assessment using spatial data multi-criteria analysis

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Abstract:

When deciding on investing, it is important to know the risks. These risks are numerous, and in the preinvestment cycle are generally assessed on the basis of well-known and well-established financial and economic methods. These methods in majority of cases do not comprehend the risk based on spatial characteristics of the investment location. There is a special field in economics called „Regional economy" or „New economic geography" which represents new approach to spatial economy. Theories within this field consider positive contextual benefits for certain business which are derived just from the fact of spatial location of the business in certain spatial surroundings. Therefore, influence of spatial characteristics is present, while current methods of risk calculations need to be upgraded by applying spatial multi-criteria decision analysis.

Therefore, there is a need to model the risk calculations based on spatial criteria, which will be carried out through this research using multi-criteria GIS analysis. The research will focus on linking spatial characteristics of local administrative areas with the development index of each local unit. The development index is a composite index which includes the following indicators: 1. unemployment rate, 2. per capita income, 3. budget revenues of local or regional self-government units per capita, 4. general population changes, 5. population education level, 6. aging index. Thus, the development index will be considered as a measure of the results of the previous (good or bad) investment. The local government unit development index (which is calculated for all local governments in the Republic of Croatia) will be taken as an economic indicator of a good (or poor) economy.

The research will be conducted using existing spatial datasets in the National Spatial Data Infrastructure (NSDI) platform, open data, and other available data. The particular spatial datasets will be challenged with development index. The main hypothesis of research is that by applying the model based on spatial characteristics and development index it is possible to calculate investment potential on local administrative area. The hypothesis will be tested using mathematical-statistical methods. The aimed and applicable spatial characteristics should be selected (e.g. distance from motorway network, proximity to railway network, average area of construction parcel or agricultural parcels, etc.), and those that couldn't have influence on investment potential should be filtered out of the model. The correlation between these spatial characteristics of local administrative area and corresponding development index will be tested using regression methods. Based on the correlation degree, the strength of influence from certain spatial characteristics on investment potential will be expressed, and accordingly the model for investment potential assessment using spatial multi-criteria data analysis will be developed.

Keywords: *development index, investment potential, local administrative area, spatial characteristics, spatial multi-criteria analysis*

Geo-Information Real Estate Mass Valuation Model to Support Spatial Planning

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Abstract:

For quality spatial planning, official registers of spatial data need to be supplemented with additional information in order to obtain more complete information about space. Mass appraisal of real estate gathers and processes information about existing real estate that can be used to analyze and predict changes in real estate values due to different planning and land use conditions. The change in the value of real estate depending on different planning conditions has been described in many analyzes articles.The increasing use of GIS in spatial planning enables better and more complex analysis of spatial data, thus improving the database to support decision-making in planning decisions. Determining the impact of spatial plans on property values is a complex and time-consuming process that takes many factors into account. Establishing an organized database would enable better and more complex analyzes of spatial data that would significantly speed up this process. In this research scientific methods will be used which aim to develop models and apply mass valuation real estate data that will provide additional information in spatial planning prodecures. The used methodology will include methods related to the research of the starting point and characteristics of the future system, the design of a theoretical model and its testing to test the hypotheses. This research will explore the possibilities of using mass appraisal of real estate data to support spatial planning and will propose the establishment of a geoinformation (GIS) model for decision support.

Key words: mass appraisal, spatial planning, land use conditions, GIS model

Coronal mass ejection (CME) 3D reconstruction was obtained for 13 events using images from coronagraphs onboard STEREO-A, STEREO-B and SOHO observatories. In order to test the subjectivity of the reconstruction procedure itself, the results were compared with the results obtained by 11 other authors.

Is field-measured tree height as reliable as believed? - A comparison study of tree height estimates from conventional field measurement and low-cost close-range remote sensing in a deciduous forest

Luka Jurjević, Xinlian Liang, Mateo Gašparović, Ivan Balenović

The tree height is one of the most important tree attributes in forest inventory. In forestry practice, it is typically measured using ultrasound or laser hypsometers, and it is one of the most difficult and time-consuming, hence expensive, tree attributes to collect. Despite the effort in the past to facilitate tree height measurements using remote sensing methods, upcoming solutions are not yet thoroughly investigated. In addition, a majority of studies were conducted in boreal forests, which significantly differ from broadleaved forests.

In this study, we investigated the applicability of different close-range remote sensing methods in height measurements of trees in the broadleaved forest. Three different close-range remote sensing sources were investigated; UAV photogrammetry (UAVimage), hand-held Personal Laser Scanner (PLShh) and UAV Laser Scanning (ULS). Despite the relatively high market price of the used remote sensing systems, they are referred to as low-cost since they consist of low-cost sensors (i.e. Velodyne VLP-16, M8 Quanergy). Six sample plots in a pedunculate oak forest were set up and measured in detail using conventional methods, which was followed by remote sensing data acquisition. Each tree in the sample plot was interactively measured in the respective point cloud and correspondence with the field measurements was verified using tree positions collected using a total station. The tree height using the conventional method was measured by three different observers and the average is used.

Cross-comparisons of different datasets were performed to evaluate the performances of different data sources in the tree height estimation with respect to crown class, tree height and species. All remote sensing data sources correlated well, e.g. biases between remote sensing sources were around ± 1%. The field-measured tree height in general correlated well with remote sensing data sources. The uncertainties and bias of the field measurements were dependent on the tree height and crown class. Field measurements tended to underestimate codominant and intermediate trees at the approximately 1 m magnitude, whilst remote sensing data sources were robust to crown classes. Low-cost ULS used in this study, and very likely in general, may not have enough penetration capability when measuring low and mostly occluded trees, causing missed treetops. PLShh gave tree height estimates closer to the real tree height than those derived from conventional field measurements for trees above 21 m height.

Development of New Methodology for Classification of Forest Cover Based on Remote Sensing Methods

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The aim of this research is to examine the possibilities of using remote sensing methods in the classification of forest cover in Croatia. It was investigated the possibility of using high-resolution satellite images for the classification of forest cover. Collecting data on forests in the traditional way (field methods) provides accurate information, but requires long-term and intensive work, and in some cases, access to certain forest areas is difficult or even impossible. By applying new technologies and remote sensing methods, the time of total work decreases and, at the same time, increases the quantitative and qualitative value of the information obtained.

The study area (2000 ha) is located in Jastrebarski lugovi management unit, 35 km southwest of Zagreb (central Croatia). It is a part of the lowland forest complex of Pokupsko Basin. The main forest type (management class) in the study area is even-aged pedunculate oak (*Quercus robur L.*) forests (covering 77% of the study area). The oak stands are mixed with secondary tree species, such as common hornbeam (*Carpinus betulus L.*), black alder (*Alnus glutinosa (L.) Geartn.*), and narrow-leaved ash (*Fraxinus angustifolia Vahl.*).

The classification was performed on eight multispectral bands of very high-resolution WorldView-3 (WV-3) (red, red edge, coastal, blue, green, yellow, near-IR1, and near-IR2). The research is applied pixel-based supervised classification using a random forest machine learning algorithm Reference polygons are used for training and validation of forest cover classification. They were defined on field-collected species and locations (5000 tree locations on 165 plots) and visual interpretation of satellite images. The interpretation was conducted using "true" and "false" color composition. The pixel-based classification was improved by a combination of spectral and textural features (gray level co-occurrence matrix – GLCM). For the applied classification method, accuracy assessment was calculated based on the individual tree species' reference polygons. Supervised classification of multispectral WV-3 images with very high accuracy detected three dominant tree species: *Alnus glutinosa, Carpinus betulus,* and *Quercus robur.*

Consequences of land readjustment on the flood regime

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After many alterations made by man in terms of land adjustment, the need to change the perspective has arisen. The process of land readjustment is in needs to be looked at from a different perspective than usual. From the perspective of a surveyor, land adjustment or land consolidation is the process of grouping the parcels owned by one or by a group of owners. In this process, the land surveyor pays attention to the area of interest in terms where the law of ownership and the resulting acreage needs to be consistent. On the other side, the hydrologists' concern is about observing processes from engineering and the ecological perspective. The main idea is whether and how these two research areas can benefit nature and the population?

To quantify the consequences of land readjustment, it is necessary to start the research in landscape heterogeneity. The main idea in dissertation is to examine the synergy between the landscape and hydrological processes. It would mean to study the effect of land distribution and vegetation and to find repeatability in forms. This would provide a prospect of simplifying the heterogeneity of a landscape to model. However, land with all its irregularities is shaped by water fluctuation. The sediments are moved in erosion or deposition, and the landscape is sewn by water. Improving existing hydrological models with landscape components is another goal in the dissertation research.

When it comes to implementing landscape components to hydrology models, there is a demand for high-quality spatial data, digital elevation models, land cover data, high-quality precipitation, and evapotranspiration data. After theoretical study and establishing the most suitable path for switching to the practical part of the dissertation research, collaboration with the state authorities and providing high-quality data is expected. In the practical part of the research, the focus will be on using the open-source software to model and perform spatial analyses such as R, QGIS, programming language Python, etc.

This research's starting strategy is to choose the area in Slovakia, where land consolidation is planned to take part soon. Then, make a group of scenarios of land readjustment based on the previous landscape-based hydrological modeling. The one outcome of a variety of land readjustment scenarios is to choose the best possible way of placement of the new parcels to minimize the floods in the future. Another expected outcome is finding the landscape patterns, enabling the implementation of this kind of hydrological modeling in various locations in Slovakia. Such action will be the simplification of the land readjustment process in terms of environmental protection.

Keywords: land readjustment, hydrology, landscape, modeling, spatial data, GIS

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Kinematic testing of the laser tracker

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Laser trackers are coordinate measuring machines used for high accuracy measurement (several tenths of micrometers) in various industry types. Besides measuring static targets, a laser tracker allows measuring moving targets as well. Many researchers put their effort into analyzing error sources and uncertainties present during measurement on a stationary target. As a result of their work, three standards addressing laser tracker testing and verification of its parameters were developed. However, kinematic testing (when the target is moving) is still an ongoing problem.

The dissertation thesis's first goal is to analyze error sources present during measurement on the moving target. Error model can be based on static measurement (as all static error sources also appear during kinematic measurement) with new additional error parameters. According to researchers, the primary error source can be considered the time synchronization between individual sensor measurements.

The next task is to verify the new proposed error model by experimental measurement with laser tracker Leica AT960. Many problems arise with designing the experiment. First, any etalon used should be determined with adequate small uncertainty. Next, synchronization between various measuring systems has great importance and should be done correctly. Because the laser tracker's control software is primarily designed for industrial applications, many functions desired for this type of experiment could be missing. Therefore, the development of a custom application is also a possibility.

The last task is to investigate possible approaches to perform kinematic testing under field conditions. This could include the development of the new equipment suitable for this task. Proposed kinematic testing in a shop-floor environment should be fast and effective with accessible equipment.

Key words: Leica AT960, error model, field test, accuracy

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Development of Geodetic Linear Scales Calibration Method – Initial Works and Tests

Abstract:

Comparator for calibration of geodetic linear scales such as levelling staffs or measuring tapes is a device that compares nominal (reference) graduation values with measured distances of graduations from zero point. Calibration is conducted to determine the actual behavior model of tested linear scale graduation. Comparators are not mass-produced and therefore are not commercially available. They must be individually designed according to the requirements of individual calibration, test, or research laboratory. Such comparator was constructed in 2002 as a part of the doctoral dissertation of prof. Đuro Barković, PhD, at the Laboratory for Measurements and Measuring Technique of the Faculty of Geodesy, University of Zagreb. Constructed comparator calibration works on the principle of distance measurement by using a linear encoder, and individual graduation lines on a geodetic linear scale are observed manually by aiming each edge of each graduation using an optical microscope. Aim of this doctoral thesis is to develop fully automated geodetic linear scales calibration method that will have uncertainty lower than 5 µm/m. It will be accomplished by updating existing comparator with a CCD camera on a servomotor driven cart. The whole calibration process will be supervised by a software developed in an open source environment. In this paper performed works on hardware update and software development will be presented, also with initial testing and results.

Keywords:
geodetic linear scales, levelling staff, calibration, CCD camera, linear encoder

Improvement and synergy of civil and military topography of the Republic of Croatia

The State Geodetic Administration began developing a strategy for the cartographic service in the 1990s. The result of the research is the development of the Official Topographic-Cartographic Information System of the Republic of Croatia or STOKIS. After STOKIS, the first version of the Croatian Topographic Information System (data model) or CROTIS was developed. Based on CROTIS, a basic topographic database (TTB) was created. The basic topographic database (first edition) was made from 1996 to 2010 and covered the entire territory of the Republic of Croatia.

During the development of the TTB and data collection, several shortcomings were encountered, and accordingly there was a need to improve this data model. Improvement has been influenced by the development and advancement of technology (hardware and software). To date, the CROTIS model has undergone 4 versions and 3 improvements.

TTB data were used mainly for the production of civilian topographic maps at a scale of 1: 25000 and military topographic maps at a scale of 1:50 000 and 1: 250 000. The process of making civilian topographic maps was manual to semi-automated and the data quality was mostly satisfactory. The process of making military topographic maps was semi-automated and in some places automated, and it was realized that the quality and structure of the data was not satisfactory. The data needed to be supplemented and refined to be suitable for the automated processing.

As most of the objects on the civilian and military maps are similar or the same, a conclusion is reached about the development of a unique model of topographic data. In order to make it, it is necessary to make a detailed analysis and testing, make a proposal to improve existing models or make a new model. TTB data are also used by other state institutions, such as ministries, local governments, urban institutes, etc. It is necessary to analyse their needs and include them in the development of a common model.

Several scientific methods will be used in the analysis: inductive and deductive method, analysis and synthesis method, abstraction and concretization method, classification method, comparative method, statistical method, modelling method, survey and interview method, etc.

Creating a common model would create even better conditions for mutual data exchange, which would be harmonized as much as possible, but also speed up the process of mapping with automated processes, raise the quality of all products, reduce costs and existing data would be even more useful and usable to other users, professions, state and public services and Ministries.

Key words: CROTIS, data model, topography, STOKIS

Smart Land Use Control in Indonesia

Abstract

There has been a long-standing interest in land conversion issues in the world. Mostly is the land conversion issues of rural to urban. In contrast, the development control system still has many weaknesses, so that land conversion takes place continuously. In Indonesia, land conversion occurs exponentially due to the growth of the urban population and transportation technology, and improved information technology. However, Indonesia's development control system still has many gaps, like weak supervision from the Government. This research will be divided into two essential understandings; land conversion and development control. This research is a combination of qualitative and quantitative research and various statistical analysis and dynamic simulation. The study consisted of primary data and secondary data and will process in Analytical Hierarchy Process, Cellular Automata, G.I.S. Analysis. This research has five targets that must be excluded, including; (1) Factors that encourage land conversion in the suburban; (2) The simulation of land-use change; (3) The optimum of a development control system; (4) The role of remote sensing technology in helping the development control system; (5) The possible strategies to have smart land use control. This research is expected to be a reference in land-use control systems based on a comprehensive understanding of land-use change dynamics and further understanding of the development control itself.

Improving the availability and usability of planetary spatial data research by spatial data infrastructure of space bodies modelling

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The rapid development of space technology with heightened interest in space exploration has resulted in the intensifying observation of celestial bodies, especially planets, their moons, and asteroids over the past decade with an upward trend perspective in the future. Large amounts of collected data on space bodies, all of which are spatially defined, impose the need to develop the spatial data infrastructure of space bodies (SDISB) at the general level in order to enable standardized organization and storage of these data, and their efficient use and exchange. In order to approach to the development of such an infrastructure, it is necessary to investigate what data, as well as how and to what extent, are collected through the space observation, either from Earth, Earth orbit or from space probes. It is also necessary to gain knowledge about the ways in which this data can be obtained and to explore all the necessary aspects of the concept of spatial data infrastructure, its establishment and operationalization. This doctoral dissertation provides a detailed overview of current archives of planetary data and their shortcomings, and examines the possibility of modelling of establishment of SDISB based on current methods of archiving planetary data using international spatial data standards and open source technologies to make planetary data more accessible to the general public allowing them to be easily searched, accessed, downloaded and interpreted.

Keywords: SDI, SDISB, planetary data