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ABSTRACT BOOK

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GEOADVANCES

AN AUTOMATED 3D INDOOR TOPOLOGICAL NAVIGATION NETWORK MODELLING

Ali Jamali[1], Alias Abdul Rahman[1], Pawel Boguslawski[2] and Christopher M. Gold[1]

[1] Universiti Teknologi Malaysia (UTM), Faculty of Geoinformation and Real Estate
ali.jamali.65@gmail.com, alias@utm.my, chris.gold@gmail.com

[2] University of the West of England, Faculty of Environment and Technology
Pawel.boguslawski@uwe.ac.uk

Abstract Indoor navigation is important for various applications such as disaster management and safety analysis. In the last decade, indoor environment has been a focus of wide research; that includes developing techniques for acquiring indoor data (e.g. Terrestrial laser scanning), 3D indoor modelling and 3D indoor navigation models. In this paper, an automated 3D topological indoor network generated from inaccurate 3D building models is proposed. In a normal scenario, 3D indoor navigation network derivation needs accurate 3D models with no errors (e.g. gap, intersect) and two cells (e.g. rooms, corridors) should touch each other to build their connections. The presented 3D modeling of indoor navigation network is based on surveying control points and it is less dependent on the 3D geometrical building model. For reducing time and cost of indoor building data acquisition process, Trimble LaserAce 1000 as surveying instrument is used. The modelling results were validated against an accurate geometry of indoor building environment which was acquired using Trimble M3 total station.

Keywords: Indoor Surveying, 3D Data Modelling, Indoor Navigation, Topology

ASSESSING SPATIAL QUALITY OF PARTICIPATORY GIS STUDIES: A CASE STUDY IN CAPE TOWN

K. Musungu

Department of Civil Engineering and Surveying, Cape Peninsula University of Technology, Cape Town, South Africa, musunguk@gmail.com

Abstract Participatory GIS (PGIS) has been prescribed by scholars who sought to find a means to enable more equitable access to GIS data, diversifying the types of knowledge captured by a GIS and re-engineering GIS software. The popularity of PGIS is evident in the various studies and contexts in which it has been utilised. These include studies in risk assessment, land administration, resource management, crime mapping and urban design to mention but a few. Despite the popularity of PGIS as a body of research, little has been done in the analysis of the quality of PGIS information. The study investigated the use of data quality criteria commonly used in traditional GIS systems and shows that it is possible to apply the criteria used in traditional GIS to PGIS. It provides a starting point for PGIS studies to assess the quality of the product. Notably, this a reflective exercise on one case study, but the methodologies used in this study have been replicated in many others undertaken by Community Based Organisations as well as Non-Governmental Organisations. Therefore the findings are relevant to such projects.

Keywords: Spatial Quality, Participatory GIS, Informal Settlements, Community-Integrated GIS, Quality criteria

BIM AND IOT: A SYNOPSIS FROM GIS PERSPECTIVE

Umit Isikdag

Mimar Sinan Fine Arts University, Department of Informatics, Istanbul, Turkey
umit.isikdag@msgsu.edu.tr

Abstract Internet-of-Things (IoT) focuses on enabling communication between all devices, things that are existent in real life or that are virtual. Building Information Models (BIMs) and Building Information Modelling is a hype that has been the buzzword of the construction industry for last 15 years. BIMs emerged as a result of a push by the software companies, to tackle the problems of inefficient information exchange between different software and to enable true interoperability. In BIM approach most up-to-date an accurate models of a building are stored in shared central databases during the design and the construction of a project and at post-construction stages. GIS based city monitoring / city management applications require the fusion of information acquired from multiple resources, BIMs, City Models and Sensors. This paper focuses on providing a method for facilitating the GIS based fusion of information residing in digital building "Models" and information acquired from the city objects i.e. "Things". Once this information fusion is accomplished, many fields ranging from Emergency Response, Urban Surveillance, Urban Monitoring to Smart Buildings will have potential benefits.

BUILDING ZONING REGULATION COMPLIANCE BASED ON LIDAR-DERIVED MODELS:REAL-LIFE TESTS

Umit Isikdag[1] and Ismail Buyuksalih[2]

[1] Mimar Sinan Fine Arts University, Department of Informatics, Istanbul, Turkey
umit.isikdag@msgsu.edu.tr
[2]BIMTAS, Istanbul,Turkey
ibuyuksalih@yahoo.com

Abstract Today, with this LiDAR data in place, it is possible to derive models and information (e.g. the heights of the buildings).This paper focuses on and explains our efforts on automatically checking Buildings' Zoning Regulation Compliance by integrating geometric information derived from 3D LiDAR data and semantic information acquired from 2D Implementation Development Maps. The 3D LiDAR data is collected and transformed into 3D Digital City Model in LOD 3. The process involves several steps, first steps include including geometry construction from point clouds, geometry checking and validation. Further steps include integration of semantic information and geometric information. Once 3D Digital City Model is constructed semantic information acquired from 2D Implementation Development Maps is integrated with this model by using a GIS. Once the integration has been made, automatic zoning regulation compliance tests are conducted. The initial test results for several cases revealed that the approach holds a great potential for Buildings' Zoning Regulation Compliance. The paper explains the implementation and testing process of the overall study.

DEVELOPMENT OF WATER QUALITY PARAMETER RETRIEVAL ALGORITHMS FOR ESTIMATING TOTAL SUSPENDED SOLIDS AND CHLOROPHYLL – A CONCENTRATION USING LANDSAT-8 IMAGERY AT POTERAN ISLAND WATER

N. Laili[1], F. Arafah[1], L.M. Jaelani[1], L. Subehi[5], A. Pamungkas[2], E.S. Koenhardono[3], A. Sulisetyono[4]

[1]Dept. of Geomatics Engineering, Faculty of Civil Engineering and Planning;
[2]Dept. of Urban and Regional Planning, Faculty of Civil Engineering and Planning;
[3]Dept. of Marine Engineering, Faculty of Marine Technology;
[4]Dept. of Naval Architecture and Shipbuilding Engineering, Faculty of Marine Technology, Institut Teknologi Sepuluh Nopember, Surabaya, 60111, Indonesia.
nurahida11@mhs.geodesy.its.ac.id, feny13@mhs.geodesy.its.ac.id, lmjaelani@geodesy.its.ac.id, adjie@urplan.its.ac.id, eddy-koen@its.ac.id, sulisea@na.its.ac.id
[5]Research Centre for Limnology, Indonesian Institute of Sciences, Cibinong Science Centre, 16911, Indonesia, uki@limnologi.lipi.go.id

Abstract The Landsat-8 satellite imagery is now highly developed compares to the former of Landsat projects. Both land and water area are possibly mapped using this satellite sensor. Considerable approaches have been made to obtain a more accurate method for extracting the information of water area from the images. It is difficult to generate an accurate water quality information from Landsat images by using some existing algorithm provided by researchers. Even though, those algorithms have been validated in some water area, but the dynamic changes and the specific characteristics of each area make it necessary to get them evaluated and validated over another water area. This paper aims to make a new algorithm by correlating the measured and estimated TSS and Chl-a concentration. We collected in-situ remote sensing reflectance, TSS and Chl-a concentration in 9 stations surrounding the Poteran islands as well as Landsat 8 data on the same acquisition time of April 22, 2015. The regression model for estimating TSS produced high accuracy with determination coefficient (R2), NMAE and RMSE of 0.709; 9.67 % and 1.705 g/m3 respectively. Whereas, Chl-a retrieval algorithm produced R2 of 0.579; NMAE of 10.40% and RMSE of 51.946 mg/m3. By implementing these algorithms to Landsat 8 image, the estimated water quality parameters over Poteran island water ranged from 9.480 to 15.801 g/m3 and 238.546 to 346.627 mg/m3 for TSS and Chl-a respectively.

Keywords: Total Suspended Solids, Chlorophyll-a, Landsat-8, Poteran Island water

DUAL HALF EDGE DATA STRUCTURE IN DATABASE FOR BIG DATA IN GIS

M. Goudarzi [1] , M. Asghari [1], P. Boguslawski [2], A. Abdul Rahman [1,3]

[1]Faculty of Geoinformation and Real Estate, University Teknologi Malaysia
(m.j.t.goudarzi, ma.asghari)@gmail.com
[2]Faculty of Environment and Technology, University of the West of England -
pawel.boguslawski@uwe.ac.uk
[3]alias@utm.my

Abstract In GIS, different types of data structures have been proposed in order to represent 3D models and examining the relationship between spatial objects. The Dual Half-Edge (DHE) is a data structure that permits the simultaneous representation of the geometry and topology of models with a special focus on building interiors. In this paper, from the storage cost point of view, the G-Maps model is analyzed and compared with the DHE model, since they have some features in common and also G-Maps is used widely in GIS. The primary result shows that the DHE is more efficient than the G-Maps with regard to the storage cost.

Keywords: Data Structures, DBMS, GIS

INTERPRETING 3D CITY MODEL BUILDING PARTS BASED ON 3D SEGMENTATION FOR URBAN MINING

Khairul Hafiz Sharkawi and Alias Abdul Rahman

Geospatial Information Infrastructure Research Group, Department of Geoinformation, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia
hafiz.sharkawi@gmail.com, alias@utm.my

ABSTRACT: Sustainability in urban development activities has gained popularity in recent years as a way to preserve the environment and its resources while achieving the development goals. One of the emerging efforts in sustainable development is urban mining – the process of upcycling and recycling compounds and elements from products, buildings, urban infrastructures and waste. Buildings in urban areas will change through time and require lots of materials for its construction. Thus, the ability to track the amount and types of minable deposits in building structures will provide a lot of advantages for all relevant parties especially the local authority. Meanwhile, 3D city models are able to increase the efficiency in analysing and managing urban areas as the 3D data are proven to represent the real world object more accurately. Furthermore, the acceptance of CityGML as one of the international standards by the Open Geospatial Consortium (OGC) increases the flexibility and consistency in exchanging 3D city models across all platforms. CityGML is a data model that able to represent the semantics, geometry, topology and appearance of 3D city models in five well-defined Level-of-Details (LoD). CityGML also emphasizes on semantic information as it can ensure the cohesiveness between geometrical and semantic representations as well as providing more attribute information on the 3D building. Due to various tools and techniques available for generating 3D city models, most of the time generated 3D buildings are only consists of geometries without any interpretation on the building parts. One of the examples is where a 3D building is normally generated as one object without any meaningful parts while the human brain can automatically interpret the real building parts visually such as Roof, Tower, Wings, Blocks, etc. Although the geometries are able to represent the building visually, it is usually insufficient to be used in any spatial analyses. This research attempts to develop a method to interpret building parts in CityGML based on 3D segmentation technique which will enable urban mining information to be integrated to the interpreted parts. Segmenting the 3D building into primitive shapes parts which will make it easier for the users to select and define the building parts. This is due to the nature of building designs where most of the parts are partitioned according to the primitive shapes that they assemble. The methodology is implemented for 3D buildings in LoD2 where the buildings are generated without architectural details but with distinct roof structures. LoD2 is deemed sufficient for this research as 3D buildings in this LoD holds the basic structure of a building even though it contain less details compare to LoD3 building. This paper introduces a 3D segmentation based on semantic decomposition in order to break down or partition a 3D building based on its semantic value and surface characteristics in assisting the interpretation of the building parts. Interpreting building parts from an un-interpreted model will enhance the building information system by allowing minable stocks inventory to be associated to each building parts. For future works, other urban

Keywords: 3D City Model, 3D Segmentation, CityGML, 3D Building Interpretation, Urban Mining

PROPOSAL FOR A WEB ENCODING SERVICE (WES) FOR SPATIAL DATA TRANSACTION

C. B. Siew, S. Peters and A. Abdul Rahman

Geospatial Information Infrastructure, Faculty of Geoinformation and Real Estate,
Universiti Teknologi Malaysia (UTM), Johor
Bahru, Malaysia
bernad@bernadsiew.name, stefanpeters@utm.my, alias@utm.my

Abstract Web services utilizations in Spatial Data Infrastructure (SDI) have been well established and standardized by Open Geospatial Consortium (OGC). Similar web services for 3D SDI are also being established in recent years, with extended capabilities to handle 3D spatial data. The increasing popularity of using City Geographic Markup Language (CityGML) for 3D city modelling applications leads to the needs for large spatial data handling for data delivery. This paper revisits the available web services in OGC Web Services (OWS), and propose the background concepts and requirements for encoding spatial data via Web Encoding Service (WES). Furthermore, the paper discusses the data flow of the encoder within web service, e.g. possible integration with Web Processing Service (WPS) or Web 3D Services (W3DS). The integration with available web service could be extended to other available web services for efficient handling of spatial data, especially 3D spatial data.

Keywords: Encoding, Web service, SDI, Data Transaction

SMART AERONAUTICAL CHART MANAGEMENT SYSTEM DESIGN

M. E. Pakdil[1,2], R. N. Celik[1], Ö. Kaya[2], Y. C. Konak [1,2], C. Guney [1]

[1]ITU, Civil Engineering Faculty, 80626 Maslak Istanbul, Turkey
(pakdilme, celikn, konak, guneycan)@itu.edu.tr
[2]Pegasus Airlines, AEROPARK, Osmanli Bulvari No:11/A, 34912 Pendik Istanbul, Turkey
(mete.pakdil, omer.kaya, celil.konak)@flypgs.com

Abstract Civil aviation is developing rapidly, and the number of domestic and international operations is increasing exponentially every year than the previous one. Airline companies with increased air traffic and the number of passengers increase the demand of new aircrafts. An aircraft needs not only fuel but also pilot and aeronautical information (charts, digital navigation information, flight plan, and etc.) to perform flight operation. One of the most important components in aeronautical information is the terminal chart. Authorized institution in every state is responsible to publish their terminal charts for certain periods. Although these charts are produced in accordance with ICAO's Annex 4 and Annex 15, cartographic representation and page layout differs in each state's publication. This situation makes difficult to read them by pilots. In this paper, standard instrument departure (SID) charts are analysed to produce by use of cutting-edge and competitive technologies instead of classical computer-aided drawing and vector based graphic applications that are currently used by main chart producers. The goal is to design efficient and commercial chart management system that is able to produce aeronautical charts with same cartographic representation for all states.

Keywords: Aeronautical, GIS, AIP, AIXM, ARINC, Chart Production

STUDY AND ANALYSIS DIACHRONIC NATURELES MEDIA AND GROWN IN THE BASIN BOUZINA (BATNA)

M. Mekaoussia H. Benmessaoudb

a Department of Natural Sciences and the Faculty of Life-El Hadj Lakhdar -University -Batna- moufidamekaoussi@gmail.com, Tel: 07 79 91 90 07

b Laboratory LRNAT -Faculté des sciences -Université El Hadj Lakhdar –Batna- Algérie ha123_m123@yahoo.fr Tél.: 00213 0668292940

ABSTRACT: The functioning of Mediterranean ecosystems to daily or interannual scale presents an ecological and socio-economic interest. The intensive exploitation of natural resources of this ecosystem by the population has now reached a critical threshold. To this is added the effect of climate change leading to a drought that occurs mainly in the southern part. This leads to accelerated degradation of the ecosystem and requires the establishment of sustainable management rules. The objective of this study is to determine the contribution of multi-date satellite images in detecting global changes and monitoring of developments in the watershed of the Aurès Bouzina center.The approach is to use satellite images Landsat at different times (1986, 2001 and 2013) and sampling work for the confrontation with the ground truth, to conduct a thematic analysis of this environment, and view the global changes that have occurred in this area. The overall reading of the results of the tracking map changes, we notice a degradation of forest cover in ascending gradient from north to south and led to the reduction of vegetation cover drills. The area of irrigated crops registered an increase of grain. In favor of bare soils and wetlands, related to the influence of rivers, as well as the emergence of forage and vegetable crops. Bare soils dominated by a sandy texture are located primarily near areas of crops due to agricultural practices based on the intensification of agriculture as well as silting soil justified by an increase in bare soil.This work is a first step to track the degradation or restoration through ecological indicators field, related to remote sensing data.

Keywords: Global Changes; Monitoring developments; Remote sensing, Aurès.

TWO LEVELS FUSION DECISION FOR MULTISPECTRAL IMAGE PATTERN RECOGNITION

H. Elmannai [1,3], M. A. Loghmari [2,3], M. S. Naceur [2,3]

[1]Ecole Supérieure des Communications de Tunis, Carthage University, 2083,Ariana, Tunisia-hela.elmannai@gmail.com

[2]Ecole Nationale d'Ingénieurs de Tunis, Université de Tunis El Manar (UTM), 1002, Tunisia

[3]Laboratoire de Télédétection et Système d'Informations à Référence Spatiale

Abstract Major goal of multispectral data analysis is land cover classification and related applications. The dimension drawback leads to a small ratio of the remote sensing training data compared to the number of features. Therefore robust methods should be associated to overcome the dimensionality curse. The presented work proposed a pattern recognition approach. Source separation, feature extraction and decisional fusion are the main stages to establish an automatic pattern recognizer. The first stage is pre-processing and is based on non linear source separation. The mixing process is considered non linear with gaussians distributions. The second stage performs feature extraction for Gabor, Wavelet and Curvelet transform. Feature information presentation provides an efficient information description for machine vision projects. The third stage is a decisional fusion performed in two steps. The first step assign the best feature to each source/pattern using the accuracy matrix obtained from the learning data set. The second step is a source majority vote. Classification is performed by Support Vector Machine. Experimentation results show that the proposed fusion method enhances the classification accuracy and provide powerful tool for pattern recognition.

Keywords: Source separation, Support Vector Machine, Feature extraction, Decisional fusion, Pattern recognition

3D INDOOR BUILDING ENVIRONMENT RECONSTRUCTION USING CALIBRATION OF RANGEFINDER DATA

Ali Jamali[1], Francois Anton[2], and Alias Abdul Rahman[1]

[1]Geospatial Information Infrastructure (GeoI2) Research Lab., Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor, Malaysia, ali.jamali.65@gmail.com, alias@utm.my

[2]Dept. of Geodesy, National Space Institute, Technical University of Denmark, Denmark fa@space.dtu.dk

Abstract Nowadays, municipalities intend to have 3D city models for facility management, disaster management and architectural planning. 3D data acquisition can be done by laser scanning for indoor environment which is a costly and time consuming process. Currently, for indoor surveying, EDM and Terrestrial Laser Scanner (TLS) are mostly used. In this paper, several techniques for indoor 3D building data acquisition have been investigated. For reducing the time and cost of indoor building data acquisition process, the Trimble LaserAce 1000 range finder is used. The accuracy of the rangefinder is evaluated and a simple spatial model is reconstructed from real data. This technique is rapid (it requires a shorter time as compared to others), but the results show inconsistencies in horizontal angles for short distances in indoor environments. The range finder was calibrated using a least square adjustment algorithm. To control the uncertainty of the calibration and of the reconstruction of the building from the measurements, interval analysis and homotopy continuation are used.

Keywords: Indoor surveying, least square adjustment, interval analysis, rangefinder, laser scanning, calibration, homotopy continuation

GENERALIZED CARTOGRAPHIC AND SIMULTANEOUS REPRESENTATION OF UTILITY NETWORKS FOR DECISION-SUPPORT SYSTEMS AND CRISIS MANAGEMENT IN URBAN ENVIRONMENTS

Thomas Becker[a], Gerhard König[a]

[a] Dept. of Geodesy and Geoinformation Science, 10263 Berlin, Germany (thomas.becker, gerhard.koenig)@tu-berlin.de

Abstract Cartographic visualizations of crises are used to create a Common Operational Picture (COP) and enforce Situational Awareness by presenting relevant information to the involved actors. As nearly all crises affect geospatial entities, geo-data representations have to support location-specific analysis throughout the decision-making process. Meaningful cartographic presentation is needed for coordinating the activities of crisis manager in a highly dynamic situation, since operators' attention span and their spatial memories are limiting factors during the perception and interpretation process. Situational Awareness of operators in conjunction with a COP are key aspects in decision-making process and essential for making well thought-out and appropriate decisions. Considering utility networks as one of the most complex and particularly frequent required systems in urban environment, meaningful cartographic presentation of multiple utility networks with respect to disaster management do not exist. Therefore, an optimized visualization of utility infrastructure for emergency response procedures is proposed. The article will describe a conceptual approach on how to simplify, aggregate, and visualize multiple utility networks and their components to meet the requirements of the decision-making process and to support Situational Awareness.

Keywords: Networks, Infrastructure, Disaster, Decision Support, GIS, Cartography, Visualization, Management, Generalization

PARTITION-BASED CLUSTERING FOR SUPPLY CHAIN DATA MANAGEMENT

Suhaibah Azri[1], Uznir Ujang[1], Francois Anton[2], Darka Mioc[2], and Alias Abdul Rahman[1]

[1]Geospatial Information Infrastructure (GeoI2) Research Lab.,
Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor, Malaysia
norsuhaibah@gmail.com, {mduznir, alias}@utm.my
[2]Dept. of Geodesy, National Space Institute, Technical University of Denmark, Denmark
{fa, mioc}@space.dtu.dk

Abstract Supply Chain Management (SCM) is the management of the products and goods flow from its origin point to point of consumption. During the process of SCM, information and dataset gathered for this application is massive and complex. This is due to its several processes such as procurement, product development and commercialization, physical distribution, outsourcing and partnerships. For a practical application, SCM datasets need to be managed and maintained to serve a better service to its three main categories; distributor, customer and supplier. To manage these datasets, a structure of data constellation is used to accommodate the data into the spatial database. However, the situation in geospatial database creates few problems, for example the performance of the database deteriorate especially during the query operation. We strongly believe that a more practical hierarchical tree structure is required for efficient process of SCM. Besides that, three-dimensional approach is required for the management of SCM datasets since it involve with the multi-level location such as shop lots and residential apartments. 3D R-Tree has been increasingly used for 3D geospatial database management due to its simplicity and extendibility. However, it suffers from serious overlaps between nodes. In this paper, we proposed a partition-based clustering for the construction of a hierarchical tree structure. Several datasets are tested using the proposed method and the percentage of the overlapping nodes and volume coverage are computed and compared with the original 3D R-Tree and other practical approaches. The experiments demonstrated in this paper substantiated that the hierarchical structure of the proposed partition- based clustering is capable of preserving minimal overlap and coverage. The query performance was tested using 300,000 points of a SCM dataset and the results are presented in this paper. This paper also discusses the outlook of the structure for future reference.

Keywords: Supply Chain Management, 3D Spatial Data Clustering, 3D Spatial Database, 3D GIS, Data Management, Information Retrieval

STORING A 3D CITY MODEL, ITS LEVELS OF DETAIL AND THE CORRESPONDENCES BETWEEN OBJECTS AS A 4D COMBINATORIAL MAP

Ken Arroyo Ohori, Hugo Ledoux and Jantien Stoter

Geoinformation, Delft University of Technology, Delft, the Netherlands
{G.A.K.ArroyoOhori, h.ledoux, j.e.stoter}@tudelft.nl

Abstract 3D city models of the same region at multiple LODs are encumbered by the lack of links between corresponding objects across LODs. In practice, this causes inconsistency during updates and maintenance problems. A radical solution to this problem is to model the LOD of a model as a dimension in the geometric sense, such that a set of connected polyhedra at a series of LODs is modelled as a single polychoron—the 4D analogue of a polyhedron. This approach is generally used only conceptually and then discarded at the implementation stage, losing many of its potential advantages in the process. This paper therefore shows that this approach can be instead directly realised using 4D combinatorial maps, making it possible to store all topological relationships between objects.

Keywords: level of detail (LOD), 4D, multi-dimensional GIS, combinatorial maps

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A DECISION SUPPORT SYSTEM THROUGH THEMATIC MAPPING OF VARIOUS GOVERNMENT SCHEMES IMPLEMENTED USING OPEN SOURCE

Bhaskar Reddy Pulsani

Telangana State Remote Sensing Applications Centre, 8th Floor, B Block, Swarnajayanti Complex, Ameerpet-38, India
pulsani@yahoo.co.in

Abstract Several schemes are undertaken by the government to uplift social and economic condition of people. The monitoring of these schemes is done through information technology where involvement of Geographic Information System (GIS) is lacking. To demonstrate the benefits of thematic mapping as a tool for assisting the officials in making decisions, a web mapping application for three government programs such as Mother and Child Tracking system (MCTS), Telangana State Housing Corporation Limited (TSHCL) and Ground Water Quality Mapping (GWQM) has been built. Indeed the three applications depicted the distribution of various parameters thematically and helped in identifying the areas with higher and weaker distributions. These applications have been developed using SharpMap Csharp library which is a free and open source mapping library for developing geospatial applications. The study brings out the advantage of using this library over proprietary vendors and further highlights upon its free and open source nature.

Keywords: Web GIS, SharpMap, Csharp, ASP.NET, Government Schemes and Programs

A NEW FRAMEWORK FOR GEOSPATIAL SITE SELECTION USING ARTIFICIAL NEURAL NETWORKS AS DECISION RULES A CASE STUDY ON LANDFILL SITES

Sohaib K. M. Abujayyab, Mohd Sanusi S. Ahamad, Ahmad Shukri Yahya and Abdul-Malik H. Y. Saad

School of Civil Engineering, Universiti Sains Malaysia, Engineering Campus, Penang, Malaysia

s.jayyab@hotmail.com, cesanusi@usm.my, ceshukri@usm.my, eng.abdulmalik@gmail.com

Abstract This paper briefly introduced the theory and framework of geospatial site selection (GSS) and discussed the application and framework of artificial neural networks (ANNs). The related literature on the use of ANNs as decision rules in GSS is scarce. As this study found, ANNs are not only adaptable to dynamic changes but also capable of improving the objectivity of acquisition in GSS, reducing time consumption, and providing high validation. ANNs make for a powerful tool for solving geospatial decision-making problems by enabling geospatial decision makers to implement their constraints and imprecise concepts. This tool offers a way to represent and handle uncertainty. Specifically, ANNs are decision rules implemented to enhance conventional GSS frameworks. The main assumption in implementing ANNs in GSS is that the current characteristics of existing sites are indicative of the degree of suitability of new locations with similar characteristics. GSS requires several input criteria that embody specific requirements and the desired site characteristics, which could contribute to geospatial sites. In this study, the proposed framework consists of four stages for implementing ANNs in GSS. A multilayer feed-forward network with a backpropagation algorithm was used to train the networks from prior sites to assess, generalize, and evaluate the outputs on the basis of the inputs for the new sites. Two metrics, namely, confusion matrix and receiver operating characteristic tests, were utilized to achieve high accuracy and validation.Results proved that ANNs provide reasonable and efficient results as an accurate and inexpensive quantitative technique for GSS.

Keywords: Geospatial site selection, Decision rule, GIS, artificial neural network, Landfill suitability map

ACCURACY ASSESSMENT OF LIDAR-DERIVED DIGITAL TERRAIN MODEL (DTM) WITH DIFFERENT SLOPE AND CANOPY COVER IN TROPICAL FOREST REGION

Mohd Radhie Mohd Salleh, Zamri Ismail and Muhammad Zulkarnain Abdul Rahman

Department of Geoinformation, Universiti Teknologi Malaysia, Johor,Malaysia

mohdradhie.gis@gmail.com, ismailzamri@gmail.com, drmuhdzulkarnain@gmail.com

Abstract Airborne Light Detection and Ranging (LiDAR) technology has been widely used recent years especially in generating high accuracy of Digital Terrain Model (DTM). High density and good quality of airborne LiDAR data promises a high quality of DTM. This study focussing on the analysing the error associated with the density of vegetation cover and terrain slope in a LiDAR derived DTM value in a tropical forest environment in Bentong, State of Pahang, Malaysia. Airborne LiDAR data were collected can be consider as low density captured by Reigl system mounted on an aircraft. The ground filtering procedure use adaptive triangulation irregular network (ATIN) algorithm technique in producing ground points. Next, the ground control points (GCP) used in generating the reference DTM and these DTM was used for slope classification and the point clouds belong to non-ground are then used in determining the relative percentage of canopy cover. The results show that terrain slope has high correlation for both study area (0.993 and 0.870) with the RMSE of the LiDAR-derived DTM. This is similar to canopy density with high value of correlation (0.989 and 0.924) obtained. This indicates that the accuracy of airborne LiDAR-derived DTM is significantly affected by terrain slope and canopy caver of study area.

Keywords: Airborne LiDAR, Accuracy, Vegetation, Slope, Tropical Forest

ADVANCED LAND IMAGER (ALI) SATELLITE DATA FOR ALTERATION MAPPING IN THE MEIDUK AND SAR CHESHMEH PORPHYRY COPPER MINING DISTRICTS, SE IRAN

Amin Beiranvand Pour and Mazlan Hashim

INSTEG, Universiti Teknologi Malaysia, Johor, Malaysia

beiranvand.amin80@gmail.com, mazlanhashim@utm.my

Abstract This study evaluates the capability of Earth Observing-1 (EO1) Advanced Land Imager (ALI) data for hydrothermal alteration mapping in the Meiduk and Sar Cheshmeh porphyry copper mining districts, SE Iran. Feature-oriented principal components selection, different and band ratioing were applied for enhancing the hydrothermally altered rocks associated with porphyry copper mineralization, lithological units and vegetation using ALI data. Mixture-tuned matched-filtering (MTMF) were tested to discriminate the hydrothermal alteration areas of porphyry copper mineralization from surrounding environment using shortwave infrared bands of ALI. Results indicated that the tested methods are able to yield spectral information for identifying vegetation, iron oxide/hydroxide and clay minerals, lithological units and discrimination of hydrothermally altered rocks from unaltered rocks using ALI data at regional scale. The achievements of this investigation indicate considerable implications for geologists to use Earth Observing-1 (EO-1) ALI data for geological purposes.

Keywords: ALI, copper exploration, Geology

ANALYSING THE SUSTAINABILITY OF URBAN DEVELOPMENT: A REVIEW ON THE POTENTIAL USE OF VOLUNTEERED GEOGRAPHIC INFORMATION

Nabila Ibrahim, Uznir Ujang, Ghazali Desa and Azman Ariffin

Tropical Map Research Lab, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor,Malaysia

nabilagis@gmail.com, mduznir@utm.my, ghazali.desa@gmail.com, azmanariffin@utm.my

Abstract The challenges of how to ensure sustainable urban development are currently one of the important agenda among governments around the world. The stakeholders require the latest and high volume of geographic information for the decision making process to efficiently respond to challenges, improve service delivery to citizens, and plan a successful future of the city. However, it is time-consuming and costly to get the available information and some of the information is not up-to-date. Recently, GeoWeb 2.0 technological advances have increased the number of volunteers from non-professional citizen to contribute to the collection, sharing, and distribution of geographic information. The information known as Volunteered Geographic Information (VGI) has generated another approach of spatial data sources that can give up-to-date, huge volume of data, and available geographic information in a low cost for various applications. With this in mind, this paper presents a review of literature based on the potential use of Volunteered Geographic Information (VGI) in measuring sustainability of urban development. The review highlighted that social, economic, and environment as three pertinent pillars relating to the use of VGI for measurement sustainable urban development. This review serves as a preliminary study to assess the quality of VGI for measuring the sustainability of urban development.

Keywords: Volunteered Geographic Information, VGI, Sustainable Urban Development, GIS

APPROACH TO CONSTRUCTING 3D VIRTUAL SCENE OF IRRIGATION AREA USING MULTI-SOURCE DATA

Shuai Cheng[1,2,3], Mingzhu Dou[4], Jinxin Wang[3], Shuqing Zhang[1,2], Xiangcong Chen[1,2]

[1]Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, China

[2]University of Chinese Academy of Sciences, Beijing, China

[3]School of Water Conservancy & Environment, Zhengzhou University, China

[4]College of Life Science, Shandong Normal University ,Jinan, China

chengshuai@neigae.ac.cn, kadmz@163.com, hnwjx2008@qq.com, zhangshuqing@neigae.ac.cn, killo007@163.com

Abstract For an irrigation area that is often complicated by various 3D artificial ground features and natural environment, disadvantages of traditional 2D GIS in spatial data representation, management, query, analysis and visualization is becoming more and more evident. Building a more realistic 3D virtual scene is thus especially urgent for irrigation area managers and decision makers, so that they can carry out various irrigational operations lively and intuitively. Based on previous researchers' achievements, a simple, practical and cost-effective approach was proposed in this study, by adopting3D geographic information system (3D GIS), remote sensing (RS) technology. Based on multi-source data such as Google Earth (GE) high-resolution remote sensing image, ASTER G-DEM, hydrological facility maps and so on, 3D terrain model and ground feature models were created interactively. Both of the models were then rendered with texture data and integrated under ArcGIS platform. A vivid, realistic 3D virtual scene of irrigation area that has a good visual effect and possesses primary GIS functions about data query and analysis was constructed. Yet, there is still a long way to go for establishing a true 3D GIS for the irrigation are: issues of this study were deeply discussed and future research direction was pointed out in the end of the paper.

Keywords: irrigation area, 3D GIS, 3D virtual scene, multi-source data, interactive modeling

CHROMITITE PROSPECTING USING LANDSAT TM AND ASTER REMOTE SENSING DATA

Amin Beiranvand Pour and Mazlan Hashim

INSTEG, Universiti Teknologi Malaysia, Johor, Malaysia
beiranvand.amin80@gmail.com, mazlanhashim@utm.my

Abstract Ophiolite complexes are interesting to study using multispectral remote sensing satellite data because of high diversity of minerals and the source of podiform chromitites. This research developed an approach to discriminate lithological units and detecting host rock of chromitite bodies within ophiolitic complexes using the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and Landsat Thematic Mapper (TM) satellite data. Three main ophiolite complexes located in south of Iran have been selected for the study. Spectral transform techniques, including minimum noise fraction (MNF) and specialized band ratio were employed to detect different rock units and the identification of high-potential areas of chromite ore deposits within ophiolitic complexes. A specialized band ratio (4/1, 4/5, 4/7) of ASTER, MNF components and Spectral Angle Mapper (SAM) on ASTER and Landsat TM data were used to distinguish ophiolitic rock units. Results show that the specialized band ratio was able to identify different rock units and serpentinized dunite as host rock of chromitites within ophiolitic complexes, appropriately. MNF components of ASTER and Landsat TM data were suitable to distinguish ophiolitic rock complexes at a regional scale. The integration of SAM and Feature Level Fusion (FLF) used in this investigation discriminated the ophiolitic rock units and prepared detailed geological map for the study area. Accordingly, high potential areas (serpentinite dunite) were identified in the study area for chromite exploration targets.The approach used in this research offers the image processing techniques as a robust, reliable, fast and cost-effective method for detecting serpentinized dunite as host rock of chromitite bodies within vast ophiolite complexes using ASTER and Landsat TM satellite data.

Keywords: ASTER, Landsat TM, chromatite

ESTIMATION OF ANNUAL AVERAGE SOIL LOSS, BASED ON RUSLE MODEL IN KALLAR WATERSHED, BHAVANI BASIN, TAMIL NADU, INDIA

S. Abdul Rahaman, S. Aruchamy, R. Jegankumar and S. Abdul Ajeez

Research Fellow, Department of Geography, Bharathidasan University, India
{abdulatgeo, profsaruchamy, jegankumar, adipoli.sss} @gmail.com

Abstract Soil erosion is a widespread environmental challenge faced in kallar watershed nowadays. Erosion is defined as the movement of soil by water and wind, and it occurs in kallar watershed under a wide range of land uses. Erosion by water can be dramatic during storm events, resulting in wash-outs and gullies. It can also be insidious, occurring as sheet and rill erosion during heavy rains. Most of the soil lost by water erosion is by the processes of sheet and rill erosion. Land degradation and subsequent soil erosion and sedimentation play a significant role in impairing water resources within sub watersheds, watersheds and basins. Using conventional methods to assess soil erosion risk is expensive and time consuming. A comprehensive methodology that integrates Remote sensing and Geographic Information Systems (GIS), coupled with the use of an empirical model (Revised Universal Soil Loss Equation-RUSLE) to assess risk, can identify and assess soil erosion potential and estimate the value of soil loss. GIS data layers including, rainfall erosivity (R), soil erodability (K), slope length and steepness (LS), cover management (C) and conservation practice (P) factors were computed to determine their effects on average annual soil loss in the study area. The final map of annual soil erosion shows a maximum soil loss of 398.58 t/ h-1/ y-1. Based on the result soil erosion was classified in to soil erosion severity map with five classes, very low, low, moderate, high and critical respectively. Further RUSLE factors has been broken into two categories, soil erosion susceptibility (A=RKLS), and soil erosion hazard (A=RKLSCP) have been computed. It is understood that functions of C and P are factors that can be controlled and thus can greatly reduce soil loss through management and conservational measures.

Keywords: Soil Erosion, Soil Loss, Erosivity, Erodbility, Erosion Risk, RUSLE, Remote Sensing and GIS

GEOLOGICAL STRUCTURE MAPPING OF THE BENTONG-RAUB SUTURE ZONE, PENINSULAR MALAYSIA USING PALSAR REMOTE SENSING DATA

Amin Beiranvand Pour and Mazlan Hashim

INSTEG, Universiti Teknologi Malaysia, Johor, Malaysia
beiranvand.amin80@gmail.com, mazlanhashim@utm.my

Abstract The Bentong-Raub Suture Zone (BRSZ) of peninsular Malaysia was selected as case study to evaluate the capability of the Phased Array type L-band Synthetic Aperture Radar (PALSAR) satellite remote sensing data for structural geology mapping in tropical environments. The structural elements in the BRSZ were enhanced using multi-polarization configuration of PALSAR data at a regional scale. Adaptive local sigma and directional filters were applied to PALSAR data for detailed structural mapping. Numerous tectonic lineaments with consistent variation in trend, length and density were detected in the study area. Structural analysis of the BRSZ reveals that two distinct parts can be defined, a western part affected mainly by ductile fabrics in the Cameron Highlands and an eastern part affected mainly by brittle deformation in the BRSZ. Ductile deformation indicates several generation of folding in the Cameron Highlands. Several faults, joints and fractures represent brittle deformation events in the BRSZ. The results of this study demonstrate the usefulness of PALSAR satellite remote sensing data for mapping geological structures in tropical environments.

Keywords: PALSAR, Malaysia, Geology

IDENTIFICATION AND MAPPING OF TREE SPECIES IN URBAN AREAS USING WORLDVIEW-2 IMAGERY

Yaseen Mustafa[1], Hendaf Habeeb[2], Alfred Stein[3] and Farooq Sulaiman[4]

[1]University of Zakho, Zakho, Iraq

[2]Directorate of Forestry, Iraq

[3]University of Twente, The Netherlands

[4]Directorate of Forestry

yaseen.mustafa@uoz.ac, hindavberwary@gmail.com, a.stein@utwente.nl, faroqmziry@gmail.com

Abstract Monitoring and mapping of urban trees are essential to provide urban forestry authorities with timely and consistent information. Modern techniques increasingly facilitate these tasks, but require the development of semi-automatic tree detection and classification methods. In this article, we propose an approach to delineate and map the crown of 15 tree species in the city of Duhok, Kurdistan Region of Iraq using WorldView-2 (WV-2) imagery. A tree crown object is identified first and is subsequently delineated as an image object (IO) using vegetation indices and texture measurements. Next, three classification methods: Maximum Likelihood, Neural Network, and Support Vector Machine were used to classify IOs using selected IO features. The best results are obtained with Support Vector Machine classification that gives the best map of urban tree species in Duhok. The overall accuracy was between 60.93% to 88.92% and κ-coefficient was between 0.57 to 0.75. We conclude that fifteen tree species were identified and mapped at a satisfactory accuracy in urban areas of this study.

Keywords: Urban tree species, Supervised classification, VHR imagery, Kurdistan Region of Iraq

IMPACT ASSESSMENT OF TROPICAL STORM HUD HUD ON COASTAL REGION OF VISAKHAPATNAM, ANDRAH PRADESH

Vivek G[1] and Srinivasa Kumar T[2]

[1]Dept. of Civil Engineering, SRM University, Kattankulathur, Kancheepuram District, Chennai-603203, India -
vivek_mpganesh@srmuniv.edu.in
[2]INCOIS, Hyderabad, Telangana-500090, India
srinivas@incois.gov.in

Abstract Tropical cyclones are some of the most damaging events.They occur in yearly cycles and affect the coastal population. Current study emphasize on recent very sever cyclonic storm Hud Hud of category 3 hurricane which had developed on 8 October 2014 and hit the coast on 12 October 2014 which caused significant changes on land and coast of Visakhapatnam, Andhra Pradesh. In the present study, we have used Remote Sensing and GIS tools for investigating and quantifying the changes in vegetation and settlement. The main aim of the study is change detection by comparing three different data. The technique used here is NDVI classification technique and other techniques like storm surge modelling for finding the tide height .Using the track map the base map will be created. Landsat image of three different dates has been used for analysis purpose. The base map consist of first image of 4 Oct 14 which will show before the cyclone, the second image of 20 Oct 14 which will show after the cyclone passes and third image will show after a month of cyclone passes 7 Dec 14 which will show the actual impact of cyclone. Using NDVI the vegetation and non-vegetation part will be extracted and classified as sparse & dense vegetation, settlement and water. For identify the change detection, the statistic has been calculated for three different dates. The inundation map has been created to show the flooded area due to the rain. Using the NDVI technique we get to know that Cyclone HUD HUD caused severe damages near to the coastal region of Visakhapatnam, which lead to human loss, injuries, house damages, road damages.

Keywords: Track Map, Base Map, Inundation Map, Statistical Table

INDOOR NAVIGATION DESIGN INTEGRATED WITH SMART PHONES AND RFID DEVICES

Ismail Rakip Karas, Yasin Ortakci, Ümit Atila and Emrullah Demiral

Computer Engineering Department, Faculty of Engineering, Karabük University, Karabük, Turkey
irkaras@gmail.com, yasinortakci@karabuk.edu.tr, umitatila@gmail.com
emrullahdemiral@gmail.com

Abstract High rise, complex and huge buildings in the cities are almost like a small city with their tens of floors, hundreds of corridors and rooms and passages. Due to size and complexity of these buildings, people need guidance to find their way to the destination in these buildings. Although there are a lot of studies about indoor navigation on 2D (two dimensional) maps, pedestrians need more realistic navigation system that routes pedestrians in buildings as 3D (three dimensional) (Musliman et al., 2009). In this study, a mobile application is developed to visualize pedestrian's indoor position as 3D in their smart phone. This mobile application has the characteristics of a prototype for indoor navigation system.

Keywords: 3D, navigation, positioning, indoor

INTEGRATED ANALYSIS AND TOOLS FOR LAND SUBSIDENCE SURVEYING AND MONITORING: A SEMI-QUANTITATIVE APPROACH

Alice Pozzoli[1], Alessandro Mosconi[1], Alberto Meroni[2] and Stefano Gagliano[2]

[1]Eni S.p.a., Geodynamic Dept., via Maritano 26, 20097 San Donato Milanese, Italy

[2]Exelis VIS, Viale Colleoni 25, 20864 Agrate Brianza MB, Italy

{alice.pozzoli, alessandro.mosconi}@eni.com

{alberto.meroni, stefano.gagliano}@exelisvis.com

Abstract This paper presents an integrated approach for land subsidence monitoring using measures coming from different sensors. Eni S.p.A. constantly surveys the land with all the state of the art and innovative techniques, and a method able to integrate the results is an important and actual topic. Nowadays the world is a multi-sensor platform, and measure integration is strictly necessary. Combining the different data sources should be done in a clever way, taking advantages from the best performances of each technique. With this purpose Exelis VIS in collaboration with Eni S.p.A. customize PISAV, an ENVI extension able to capitalize on and combine all the different data collected in the surveys. In this article are presented some significant examples to show the potential of this tool: a hydrocarbon storage field where the comparison between SAR and production volumes emphasise a correlation between the two measures; and the Satellite Survey Unit (S.S.U.), where SAR, CGPS, piezometers and assestimeters measure in the same area at the same time, giving the opportunity to analyse data contextually. The integrated analysis has different advantages in monitoring the land subsidence: permits a first qualitative "differentiation" of the natural and anthropic component of subsidence, and also gives more reliability and coverage to each measurement, taking advantages from the strong points of each technique.

Keywords: Oil and Gas, Surveying, Integrated analysis

INTEGRATION OF PALSAR AND ASTER SATELLITE DATA FOR GEOLOGICAL MAPPING IN TROPICS

Amin Beiranvand Pour and Mazlan Hashim

INSTEG, Universiti Teknologi Malaysia, Johor, Malaysia

beiranvand.amin80@gmail.com, mazlanhashim@utm.my

Abstract This research investigates the integration of the Phased Array type L-band Synthetic Aperture Radar (PALSAR) and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite data for geological mapping applications in tropical environments. The eastern part of the Central Belt of peninsular Malaysia has been investigated to identify structural features and mineral mapping using PALSAR and ASTER data. Adaptive local sigma and directional filters were applied to PALSAR data for detecting geological structure elements in the study area. Vegetation, mineralogic and lithologic indices for ASTER bands were tested in tropical climate. Lineaments (fault and fractures) and curvilinear (anticline or syncline) were detected using PALSAR fused image of directional filters (N-S, NE-SW, and NW-SE).Vegetation index image map show vegetation cover by fusing ASTER VNIR bands. High concentration of clay minerals zone was detected using fused image map derived from ASTER SWIR bands. Fusion of ASTER TIR bands produced image map of the lithological units. Results indicate that data integration and data fused from PALSAR and ASTER sources enhanced information extraction for geological mapping in tropical environments.

Keywords: ASTER, PALSAR, Geological Mapping, Tropics

MOBILE APPLICATION FOR FIELD DATA COLLECTION ON GANODERMA DISEASE OF OIL PALM IN OIL PALM PLANTATION FOR SMART PHONE

Ahmad Fikri Abdullah and Nur 'Atirah Muhadi

Jabatan Kejuruteraan Biologi dan Pertanian, Fakulti Kejuruteraan, Universiti Putra Malaysia, Serdang, Malaysia

ahmadfikri@upm.edu.my, tiramuhadi@gmail.com

Abstract Nowadays, smart phone has become a necessity as it offers more than just making a phone call. Smart phone combines the features of cell phone with other mobile devices such as personal digital assistant (PDA) and GPS navigation unit that propel the popularity of smart phones. In recent years, the interest in mobile communication has been increased. Previous research using mobile application has been successfully done in varies areas of study. Areas of study that have been done are health care, education, and traffic monitoring. Mobile application has also been applied in agricultural sector for various purposes such as plant pest risk management. In this study, mobile application for data collection on Ganoderma disease of oil palm has been successfully developed. The application uses several devices in a smart phone such as GPS, Wifi/ GPRS connection and also accelerometer devices. The application can be installed in the smart phone and users can use the application while working on-site. The data can be updated immediately through their smart phones to the service. Besides, the application provides offline map so the user can be productive even though their network connectivity is poor or non-existent. The data can be synced when the users online again. This paper presents an application that allows users to download features from a sync-enabled ArcGIS Feature Service, view and edit the features even when the devices fail to connect with any network connectivity while collecting data on-site.

Keywords: Mobile application, Field data collection, Ganoderma, Smart phone

PARAMETRIC ANALYSIS FOR AUTOMATED EXTRACTION OF ROAD EDGES FROM MOBILE LASER SCANNING DATA

Pankaj Kumar[1], Paul Lewis and Conor[2] P McElhinney[2]

[1]Department of Geoinformation, Universiti Teknologi Malaysia, Johor Bahru, Malaysia

pankajkumar@utm.my

[2]National Centre for Geocomputation, National University of Ireland Maynooth, Ireland

paul.lewis@nuim.ie, conormce@cs.nuim.ie

Abstract The applicability of mobile laser scanning systems continue to prove their worth in route corridor mapping due to the rapid, continuous and cost effective 3D data acquisition capability. LiDAR data provides a number of attributes which can be useful for extracting various road features. Road edge is a fundamental feature and its accurate knowledge increases the reliability and precision of extracting other road features. We developed an automated algorithm for extracting left and right edges from mobile laser scanning data. The algorithm involved several input parameters which are required to be analysed in order to find their optimal values. In this paper, we present a detailed analysis of the dimension parameters of input data and raster cell in our algorithm. These parameters were analysed based on temporal, completeness and accuracy performance of our algorithm for their different sets of values. This analysis provided the estimation of an optimal values of parameters which were used to automate the process of extracting road edges from mobile laser scanning data.

Keywords: Mobile Laser Scanning, Road Edges, Extraction, Automation, Parameters

POSSIBILITIES OF LAND ADMINISTRATION DOMAIN MODEL (LADM) IMPLEMENTATION IN NIGERIA

Babalola Sunday, Alias A. Rahman, Tan Liat Choon and Peter Van Oosterom.

Department of Geoinformation, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
akanbiedu@yahoo.com, alias@utm.my, tlchoon@utm.my, p.j.m.vanoosterom@tudelft.nl

Abstract LADM covers essential information associated components of land administration and management including those over water and elements above and below the surface of the earth. LADM standard provides an abstract conceptual model with three packages and sub-package. LADM defined terminology for land administration system that allows a shared explanation of different formal customary or informal tenures. The standard provides the basis for national and regional profiles and enables the combination of land management information from different sources in a coherent manner. In view of this, this paper started with the description of land and land administration in Nigeria. The pre-colonial, colonial and post-colonial era with organization structure was discussed. This discussion is important in order to present an understanding to the background of any improvement needed for the LADM implementation in Nigeria. The LADM, ISO 19152 and the packages of LADM was discussed and the comparison of the different aspects of each packages and classes were made with Nigerian land administration and the cadastral system. In the comparison made, it was discovered that the concept is similar to LADM in Nigerian land administration. Although, the terminology may not be the same in all cases, having studied conceptualization and the application of LADM, as a model that has essential information associated with components of the land administration including those on the land, over water as well as elements above and below the surface of the earth and discovered that the standard is suitable for the country, the model can therefore be adopted into Nigerian land administration system by mapping in some of the concept of LADM.

Keywords: LADM, Land Administration, Land Reform, Land use Act

PUBLIC PERCEPTION ON DISASTER MANAGEMENT USING VOLUNTEERED GEOGRAPHIC INFORMATION (VGI): CASE OF UAE

M. M. Yagoub, PhD

Department of Geography and Urban Planning, Faculty of Humanities and Social Sciences
United Arab Emirates University, P. O. Box 17771, Al Ain, E-mail: myagoub@uaeu.ac.ae

Abstract The number of smart phones that are supported by location facility like Global Positioning System (GPS), Camera and connected to the internet has increased sharply in UAE during the last five years. This increase offers a chance to capitalize on using these devices as resources for data collection, therefore reducing cost. In many cases specific events may happen in areas or at time where there may be no governmental departments to collect such unrepeated events. The current research will showcase various studies that had been conducted on Volunteered Geographic Information (VGI) debating various aspects such as accuracy, legal issues, and privacy. This research will also integrate Geographic Information System (GIS), VGI, social media tools, data mining, and mobile technology to design a conceptual framework for promoting public participation in UAE. The data gathered through survey will be helpful in correlating various aspects of VGI. Since there are diverse views about these aspects, policy makers are left undecided in many countries about how to deal with VGI. The assessment of the UAE case will contribute to the age-long debate by examining the willingness of the public to participate. The result will show the public perception to be as sensors for data collection. Additionally, the potential of citizen involvement in the risk and disaster management process by providing voluntary data collected for VGI applications will also be explored in the paper.

Keywords: VGI, UAE, public perception, disaster management.

REGIONAL GEOLOGICAL MAPPING IN TROPICAL ENVIRONMENTS USING LANDSAT TM AND SRTM REMOTE SENSING DATA

Amin Beiranvand Pour and Mazlan Hashim

INSTEG, Universiti Teknologi Malaysia, Johor, Malaysia
beiranvand.amin80@gmail.com, mazlanhashim@utm.my

Abstract Landsat Thematic Mapper (TM) and Shuttle Radar Topography Mission (SRTM) data were used to produce geological maps in tropical environments. Lineament, lithology and landform maps were produced for all states in peninsular Malaysia in this study. Kedah, Perak and Terengganu states have been selected as case studies to demonstrate the results of the data and techniques used. Directional filtering technique was applied to Landsat TM bands 4, 5 and 3 for lineament mapping. The lithology map was produced using Landsat TM bands combination consist of bands 4, 3 and 2. Digital elevation model and landform map were produced using SRTM data in 3 Dimension (3D) and 2 Dimension (2D) perspective views, respectively. The produced geological maps and the remote sensing data and methods applied in this study are mostly appropriate for hazard risk mapping applications and mineral exploration projects in the peninsular Malaysia and tropical environments.

Keywords: Landsat Thematic Mapper, SRTM, regional geology mapping

TECTONIC MOTION OF MALAYSIA: ANALYSIS FROM YEARS 2001 TO 2013

Jespal Gill, Noor Suryati Mohd Shariff, Kamaludin Omar and Zulkarnaini Mat Amin

Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
jespal.g@gmail.com, suryatishariff@gmail.com, kamaludinomar@utm.my, zulkarnaini@utm.my

Abstract This paper seeks to investigate the tectonic motion of Malaysia using the Malaysian Active GPS Station (MASS) and Malaysia Real-time Kinematic GNSS Network (MyRTKnet) data from years 2001 to 2013. GNSS data were processed using Bernese 5.0, and plotted as a time series; whereby the period before and after the 2004 Sumatra-Andaman mega earthquake are plotted separately. From the time series, episodic events and stable inter-seismic deformation period are analysed. The results indicate that the 2001-2004 and 2008-2011 periods were free from episodic events; hence, chosen to depict the tectonic motion of Malaysia before and after 2004 Sumatra-Andaman earthquake, respectively. The motion had a major change in direction and rate, especially for East Malaysia and South Peninsular Malaysia. This indicates there exist a long-term post-seismic deformation due to the 2004 mega earthquake. Nonetheless, the 2008-2011 inter-seismic period is stable, and suitable to represent the current long-term tectonic motion of Malaysia: Peninsular and East Malaysia moves south-east, at an average velocity of 0.89 ±0.01 cm/yr south and 1.70 ±0.02 cm/yr east, and 1.06 ±0.01 cm/yr south and 2.50 ±0.02 cm/yr east, respectively. In addition, the co-seismic motion for the 2005 Nias, 2007 Bengkulu and 2012 Northern Sumatra earthquakes after the 2004 Sumatra-Andaman earthquake are relatively small, indicating these three earthquakes have no significant contribution to the long-term tectonic motion of Malaysia. Overall, this paper aims to provide a general insight into the tectonic motion of Malaysia which, expectedly, may benefit other scientific fields.

Keywords: Tectonic Motion, Earthquakes, GNSS

TEMPORAL STATISTIC OF TRAFFIC ACCIDENTS IN TURKEY

Saffet Erdogan, Mustafa Yalcin, Mustafa Yilmaz and Aysegul Korkmaz Takim

Faculty of Engineering, Geomatic Engineering Department, Afyon Kocatepe University, Afyonkarahisar, Turkey

Serdogan@aku.edu.tr, mustafayalcin86@gmail.com, mustafayilmaz@aku.edu.tr, akorkmaz5@kgm.gov.tr

Abstract Traffic accidents form clusters in terms of geographic space and over time which themselves exhibit distinct spatial and temporal patterns. There is an imperative need to understand how, where and when traffic accidents occur in order to develop appropriate accident reduction strategies. An improved understanding of the location, time and reasons for traffic accidents makes a significant contribution to preventing them. Traffic accident occurrences have been extensively studied from different spatial and temporal points of view using a variety of methodological approaches. In literature, less research has been dedicated to the temporal patterns of traffic accidents. In this paper, the numbers of traffic accidents are normalized according to the traffic volume and the distribution and fluctuation of these accidents is examined in terms of Islamic time intervals. The daily activities and worship of Muslims are arranged according to these time intervals that are spaced fairly throughout the day according to the position of the sun. The Islamic time intervals are never been used before to identify the critical hour for traffic accidents in the world. The results show that the sunrise is the critical time that acts as a threshold in the rate of traffic accidents throughout Turkey in Islamic time intervals.

Keywords: Traffic accident, temporal analysis, Islamic daylight time interval.

PERCEPTION OF THE PUBLIC TO VOLUNTEER GEOGRAPHIC INFORMATION: CASE OF UAE

M. Yagoub

Faculty of HSS, UAE University, United Arab Emirates

Abstract The number of smart phones that are supported by location facility (GPS), Camera and connected to the internet has increase sharply in UAE during the last five years. The increase offers a chance to capitalize on using these resources for data collection, therefore reducing cost. In many cases specific events may happen in areas or at time where there may be no governmental departments to collect such unrepeated events. This will showcase various researches that had been conducted on Volunteer Geographic Information (VGI) debating various aspects such as accuracy, legal issues, and privacy. The research integrated GIS, Volunteered Geographic Information (VGI), social media tools, data mining, and mobile technology to design a conceptual framework for promoting public participation in UAE with correlation and reliability analysis performed on the survey response data. Since there are diverse views about these aspects, policy makers are left undecided in many countries about how to deal with VGI. The assessment of the UAE case contributes to the age-long debate by examining the willingness of the public to participate. The results show that the public willingness to be as sensors for data collection varies, but in general is low. Additionally, the potential involvement of citizens in the risk and disaster management process by providing voluntary data collected from volunteered geographic information (VGI) applications is explored.

Keywords: VGI, UAE, public perception, disaster management

VISUAL INSPECTION OF WATER LEAKAGE FROM GROUND PENETRATING RADAR RADARGRAM

Nurniesya Nabila Halimsyah, Amalina Yusup, Zulkarnaini Mat Amin and Mimi Diana Ghazali

Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
niesyabella@yahoo.com, amalina24@live.utm.my, zulkarnaini@utm.my
mimidiana@perlis.uitm.edu.my

Abstract Water loss in town and suburban is currently a significant issue which reflect the performance of water supply management in Malaysia. Consequently, water supply distribution system has to be maintained in order to prevent shortage of water supply in an area. Various techniques for detecting a mains water leaks are available but mostly are time-consuming, disruptive and expensive. In this paper, the potential of Ground Penetrating Radar (GPR) as a non-destructive method to correctly and efficiently detect mains water leaks has been examined. Several experiments were designed and conducted to prove that GPR can be used as tool for water leakage detection. These include instrument validation test and soil compaction test to clarify the maximum dry density (MDD) of soil and simulation studies on water leakage at a test bed consisting of PVC pipe burying in sand to a depth of 40 cm. Data from GPR detection are processed using the Reflex 2D software. Identification of water leakage was visually inspected from the anomalies in the radargram based on GPR reflection coefficients. The results have ascertained the capability and effectiveness of the GPR in detecting water leakage which could help avoiding difficulties with other leak detection methods.

Keywords: Water leaks, GPR, Radargram

VORONOI DIAGRAMS WITHOUT BOUNDING BOXES

Erik Tjong Kim Sang

Meertens Institute, The Netherlands.
erik.tjong.kim.sang@meertens.knaw.nl

Abstract We present a technique for presenting geographic data in Voronoi diagrams without having to specify a bounding box. The method restricts Voronoi cells to points within a user-defined distance of the data points. The mathematical foundation of the approach is presented as well. The cell clipping method is particularly useful for presenting geographic data that is spread in an irregular way over a map, as for example the Dutch dialect data displayed in Figure 2. The automatic generation of reasonable cell boundaries also makes redundant a frequently used solution to this problem that requires data owners to specify region boundaries, as in Goebl (2010) and Nerbonne et al (2011).

Keywords: Voronoi Diagrams, Maps, Languages, Dialects3DGeoinfo

3D GEOINFO

3D COMPLETE TRAFFIC NOISE ANALYSIS BASED ON CITYGML

Lu Lu, Thomas Becker and Marc-Oliver Lowner

TU Berlin, Germany

lulu5399@gmail.com, {thomas.becker, m.loewner } @tu-berlin.de

Abstract Nowadays, transportation plays a more and more significant role in our daily life but produces noise. Noise not only causes annoyance and health problems, but also shows effects on economics. In 2002, the European Union published the Common Noise Assessment methods (Kephalopoulos et al 2012). The objective of this paper is to present a method for simulating the noise propagation in 3D and calculating traffic noise on building façade level with different height by using 3D city model and integrating all noise coming from individual traffic such as cars or motorcycles as well as planes and railroad based vehicles. Since this noise sources are located in our 3D urban environment - the analysis and the mapping has to cover the 3D aspect as well. A neighborhood of Berlin was chosen as research area. Currently, we propose a semi-automatic solution for 3D noise mapping: generating 3D observer points from CityGML building data; modeling 3D propagation path and calculating different kinds of traffic noise level. The total noise levels are then calculated by estimating the total annoyance based on effect equivalent sound pressure levels for different types of traffic source. The results are presented as a 3D map. In the future this approach can be further developed to an on-the-fly tool, that makes use publicly available data and processes to determine the noise for one building to a certain point in time. Besides that we found out that more investigation and evaluation on noise calculation methods are needed. Thus the development of near real time calculation methods together with noise measurements is required.

Keywords:noise traffic analysis, CityGML, noise mapping, noise determination

3D MARINE ADMINISTRATION SYSTEM BASED ON LADM

Aikaterini Athanasiou, Ioannis Pispidikis and Efi Dimopoulou

School of Rural and Surveying Engineering, National Technical University of Athens, Greece

catherineathanasiou@gmail.com, pispidikisj@yahoo.gr, efi@survey.ntua.gr

Abstract Maritime environment, acknowledging the precedence of the terrestrial boarders, needs to be organized and precisely determined whereas the interests involved are complex and wide. The registration of marine boundaries is a necessary condition for the protection of an alive organism, which flows, changes, reverses itself, but it is not limitless.The research has confirmed that the common pattern of people land relationships exists in the marine environment. Also the marine cadastre concept suggests that the complexity of interests in marine space is similarly encountered in land. The extension of cadaster functions from land to marine space is considered reasonable. The main objective of this paper is to organize the RRRs included in marine space and to develop a marine administration model, based on LADM, followed by the database implementation.

Keywords: Marine Administration System, LADM, 3D modelling, 3D cadastre

A 3D LADM PROTOTYPE IMPLEMENTATION IN INTERLIS

Eftychia Kalogianni[1], Efi Dimopoulou[2] and Peter van Oosterom[3]

[1,3]National University of Athens, Greece

[2]TU Delft, The Netherlands

efkaloyan@gmail.com, efi@survey.ntua.gr, P.J.M.vanOosterom@tudelft.nl

Abstract The massive developments and uses of high-rise buildings indicated that the demand for use of space above and below the ground surface is rapidly increasing in re-cent years also in Greece. The existing cadastral model does not cover the need for 3D and does not conform to international standards. In this paper, the proposed model is considered as an effort for overcoming previous shortcomings, introducing a model based on international standards, including the wide range of different types of spatial units, organized in levels according to the LA_Level structure of ISO19152 LADM. It is a proposal for a comprehensive 3D multipurpose LAS supporting 2D and 3D cadastral registration in Greece.A prototype system was developed to discover the possibilities and limitations of the conceptual model, as well as to investigate the efficiency of technological tools. Experience from the prototype will be used to further improve the conceptual model. The steps that were followed was the description of the prototype in UML diagrams, the use of INTERLIS, Swiss standard for geo-information exchange, convert and/or create sample data into model, decide the technical model/format to implement and visualize the result in 3D environment. In this paper it is explored how INTERLIS and LADM complement each other in actual implementation of land administration system based on LADM. During the development of the prototype many design decision have been taken and analyzed below, together with technical problems and challenges posed for future work.

Keywords: LADM, INTERLIS, constraints, 3D cadastre, technical model

A DATA MODEL FOR THE INTERACTIVE CONSTRUCTION AND CORRECTION OF 3D BUILDING GEOMETRY BASED ON PLANAR HALF-SPACES

Martin Kada, Andreas Wichmann, Nina Manzke and Yevgeniya Filippovska

University of Osnabrueck, Germany

{martin.kada, Andreas.Wichmann, nina.manzke, yevgeniya.filippovska} @uni-osnabrueck.de

Abstract 3D city models of large areas can only be efficiently (re-)constructed using automatic approaches. But since there is always a certain number of buildings where the automation fails, there is a need for interactive construction and correction tools. These tools should ideally use the reconstruction results as input, so that the amount of manual labor is minimized. However, automatic 3D building reconstruction approaches make use of different solid modeling techniques that are not all suitable for interactive modeling purposes. One such representation is half-space modeling that exhibits several advantages for the automatic (re-)construction of 3D building models (from segmented point clouds). Because planar half-spaces are infinite entities that are usually represented as mathematical inequality equations, it is difficult to design an interactive modeling system that allows their direct manipulation. In this paper, we propose an interactive modeling concept specifically for 3D building geometry based on a half-space kernel. Following from it, a special-purpose object-oriented data model is developed that hides the kernel under a layer of parameterized primitives and boundary representation (B-rep) that are better comprehensible to human users. Its hierarchical class structure reflects the interactive steps of the modeling concept and gives meaning to its modeling elements.

Keywords: 3D Modeling, Buildings, Data Model, Interactive

A METHODOLOGY FOR MODELLING OF 3D SPATIAL CONSTRAINTS

Daniel Xu, Peter Van Oosterom and Sisi Zlatanova

Accenture, and TU Delft, The Netherlands

xusifeng@gmail.com, {s.zlatanova, p.j.m.vanOosterom} @tudelft.nl

Abstract In this work we demonstrate a new methodology to conceptualise and implement geo-constraints in 3D, which has not been widely explored yet. This is done in four stages from natural language to implementation, in which geometric primitives and OCL play a crucial role to formulate the constraints. A database including various 3D topographic objects (e.g. buildings, trees, roads, grass, water-bodies and terrains) from CityGML (no constraints yet) is used as a case study to apply the developed methodology. In this research, a first attempt to formulate 3D geo-constraints in OCL is made. UML class diagram has been extended with graphical symbols for indicating constraints between classes (in addition to the additional compartment within a class for a class constraint). These constraint expressions can be tested and translated to other models/implementations when the OCL standard is extended with spatial types and operations. During this research, new types of constraints are defined as follows: general-level constraints (applicable to all object sub-classes), parameterised constraints (containing numeric values, e.g. maximum distance), constraints allowing exceptional instances (to resolve cases that have not been defined) and constraints relating to multi-scale representations (to check the consistency between two levels of detail which model the same object). Additionally common sense rules to detect conflicting constraints are specified as well.

Keywords: 3D, Spatial, Constraints, OCL, Database, Model Driven Architecture

A SPATIO-SEMANTIC QUERY LANGUAGE FOR THE INTEGRATED ANALYSIS OF CITY MODELS AND BUILDING INFORMATION MODELS

Simon Daum, André Borrmann and Thomas Kolbe

Chair of Computational Modeling and Simulation,TU Munich, Munich, Germany

{simon.daum, andre.borrmann, thomas.kolbe} @tum.de

Abstract Nowadays, urban planners are facing the challenge that distinct semantic-geometric data models are applied in the architecture/ engineering/ construction domain and in the geospatial domain. However, decision making regarding complex questions of urban planning and engineering requires to combine these two domains and their data models to create a comprehensive information space. Currently, the necessary joint information is created by converting data between the two domains. Since the employed modelling differs conceptually such a conversion results in information loss. To overcome this issue, this contribution presents a spatio-semantic query language that allows to analyze IFC building information models and geospatial CityGML models in an integrated context. Instead of converting between IFC and CityGML, a holistic information space is realized by an intermediate layer that abstracts from the two schemas of spatio-semantic modelling.

Keywords: QL4BIM, BIM, CityGML, IFC, Spatio-semantic query language

ASSESSING THE SUITABILITY OF USING GOOGLE GLASS IN DESIGNING 3D GEOGRAPHIC INFORMATION FOR NAVIGATION

Kelvin Wong[1] and Claire Ellul[2]

[1]Department of Computer Science, University College London, London, UK

[2]Department of Civil, Environmental and Geomatic Engineering,University College London, London, UK

{kelvin.wong.11, c.ellul} @ucl.ac.uk

Abstract No longer are we bound by traditional 2D physical representations; there is a steady shift towards three-dimensional (3D) data. Existing research recognises landmarks to be important navigationally but specific requirements for geometric and semantic attributes in 3D have not been identified. This study assesses the suitability of using Google Glass in real-world experiments investigating the saliency of environmental objects which facilitate pedestrian navigation. From the experiment carried out with fourteen participants, initial results show geometric and semantic detail for navigation are most pertinent between 1.65 — 7.5m for buildings. Visual characteristics such as colour, shape and texture are more relevant than function and use.

Keywords: Navigation, Google Glass, Landmarks, User-Centred Design

AUTOMATIC SEMANTIC AND GEOMETRIC ENRICHMENT OF CITYGML BUILDING MODELS USING HOG-BASED TEMPLATE MATCHING

Jon Slade, Christopher B. Jones and Paul L. Rosin

School of Computer Science & Informatics, Cardiff University, United Kingdom

{sladejd, jonescb2, rosinpl} @cardiff.ac.uk

Abstract Semantically rich 3D building models give the potential for a wealth of rich geo-spatially-enabled user experiences such as cultural heritage augmented reality, as an aide for urban planning, in radio network planning and personal navigation. However, the majority of existing building models lack much if any semantic de-tail. This work demonstrates a novel method for automatically locating sub-classes of windows and doors, using computer vision techniques including the histogram of oriented gradient (HoG) template matching, and automatically creating enriched CityGML content for the matched windows and doors. Good results were achieved for class identification with potential for further refinement of sub-classes of windows and doors and other architectural features. It is part of a wider project to bring even richer semantic content to 3D geo-spatial building models.

Keywords: Semantic, Geometric, CityGML, HoG, Template Matching

CARTOGRAPHIC ENRICHMENT OF 3D CITY MODELS - STATE OF THE ART AND RESEARCH PERSPECTIVES

Stefan Peters[1], Mathias Jahnke[2], Christian Murphy[3], Liqiu Meng[4] and Alias A. Rahman[5]

[1,2,3,4]Institute of Cartography, TU Munich, Germany,Department of Geoinformation,
[2]University of Technology Malaysia, Johor,Malaysia
speters.tum@gmail.com, mathias.jahnke@tum.de, christian.murphy@tum.de,
liqiu.meng@tum.de, alias@utm.my

Abstract This paper reports on cartographic enrichments of three dimensional geovirtual environments including the representation of 3D city models. In the re-cent years 3D city models have become effective and powerful tools that sup-port the simulation and visualization of our real world in a more and more realistic and detailed way. At the same time, there is a growing interest in comprising more information in the virtual living environment in addition to interior and exterior geometric features, roof and facade textures. A lot of information is related to houses, floors, flats, rooms, etc. but also to persons or specific features at certain urban locations. The paper presents the state of the art of cartographic principles in 3D city models, discusses approaches of cartographic enrichments with the aim to bring added values to the visual exploration of 3D geovirtual environments and reveals missing cartographic design rules within this area.

Keywords:3D city models, cartographic enrichment, information mapping

COMPARISON OF 2D & 3D PARAMETER-BASED MODELS IN URBAN FINE DUST DISTRIBUTION MODELLING

Yahya Ghassoun[1] and Marc-Oliver Löwner[2]

[1]Technische Universität Braunschweig, Germany,[2]TU Berlin, Germany
y.ghassoun@tu-bs.de, m.loewner@tu-berlin.de

Abstract In the present study two LUR models were established and compared, the first model used 2D parameters derived from an Open Street Map project data (OSM) and the second model used 3D parameters derived from a CityGML-based 3D city model. Both models predict fine-dust concentrations by using urban morphological and semantic parameters. The models were applied to a 2 km² study area in Berlin, Germany. The 2D-LUR model explained 84% of the variance of TNC for the full data set with root mean square error (RMSE) of 3284 cm-3. 3D-LUR 79% of the variance with RMSE of 3534 cm-3. Both models are capable to depict the spatial variation of TNC across the study area and both models showed relatively similar deviation from the measured TNC. 3D-LUR needed less parameters than 2D-LUR model and the semantic parameters (streets type) played a significant role in both models.

Keywords: Fine dust distribution modelling, 3D City Models, Land Use Regression Modelling

DOES A FINER LEVEL OF DETAIL OF A 3D CITY MODEL BRING AN IMPROVEMENT FOR ESTIMATING SHADOWS?

Filip Biljecki, Hugo Ledoux, and Jantien Stoter

3D Geoinformation, Delft University of Technology, Delft, The Netherlands
f.biljecki@tudelft.nl, h.ledoux@tudelft.nl, j.e.stoter@tudelft.nl

Abstract “Not always.”

Keywords: Shadow; Level of detail; CityGML; Accuracy; Quality

FRAMEWORK FOR ON AN OPEN 3D URBAN ANALYSIS PLATFORM BASED ON OGC WEB SERVICES

Marc-Oliver Lowner and Thomas Becker

Institute for Geodesy and Geoinformation Science, Berlin, Germany
{thomas.becker, m.loewner } @tu-berlin.de

Abstract The Open Geospatial Consortium (OGC) is the driving organization for the specification of Web Processing Services (WPS) that enables distributed execution of computing processes. However, WPS are not widely distributed in the field of urban analysis. We identified eco-nomic relevance of projects that hinder an open source like publica-tion, complexity of projects and therefore limited reusability of code and algorithms from these projects, very specific and geographically bound projects, and, a lack of publication culture for the reluctance of publishing open accessible WPS. Here we present a general framework for the publication or reusable WPS that enables both, the full reusability of algorithms and the pos-sibility to develop business models. A small scaled WPS, the Ab-stractKeyProcesses like Algorithm, Transformer and Inquirer are introduced for the publication of open accessible, atomic and reusable services. Further aggregated more advanced analysis can be published by the use of KnowledgeBasedChainedProcesses that may be published either as open access or represent already business models. In a last step even complete Projects may be implemented as so called ProblemSolvers. Being aware not to present a fully elaborated standard, we give information about the components, transfer values and communication in a conceptual way. Further, we discuss the benefits of this approach along an example of relevance in the field of urban analysis.

Keywords: integrated urban analysis modelling, city model, web processing service, geography markup language, OGC

HIGHLY EFFICIENT COMPUTER ORIENTED OCTREE DATA STRUCTURE AND NEIGHBOURS SEARCH IN 3D GIS

Noraidah Keling, Izham Mohamad Yusoff, Habibah Lateh and Muhamad Uznir Ujang

Universiti Sains Malaysia,Universiti Teknologi Malaysia
noraidahkeling@gmail.com, izham.usm@gmail.com, habibah@usm.my, muhamaduznir@gmail.com

Abstract Three-dimensional (3D) visualization has given a new perspective in various fields such as urban planning, hydrology, infrastructure modelling and geology. This is due to its capability of handling real world object in more realistic manners, rather than the two-dimensional (2D) approach. However, implementation of 3D spatial analysis in the real world situations has proven to be difficult to comprehend due to the complexity of the algorithm, computational process and time consuming. The existing Geographical Information Systems (GIS) enable 2D and two-and-a-half-dimensional (2.5D) spatial datasets, but less capable of supporting 3D data structures. Recent development in Octree showed that more effort was given to improve the weakness of Octree in finding neighbouring nodes by using various address encoding scheme with specific rule like matrix, lookup table and arithmetic to eliminate the need of tree traversal. Therefore, the purpose of this paper is to propose a new method to speed up the neighbouring search by eliminating the needs of complex operation to extract spatial information from Octree by preserving 3D spatial information directly from the Octree data structure. This new method will be able to achieve O(1) complexity and utilizing Bit Manipulation Instruction 2 (BMI2) to speed up address encoding, extraction and voxel search 1000x compared to generic implementation.

Keywords: 3D GIS, Octree, Neighbour search

INTERACTIVE AND VIEW-DEPENDENT SEE-THROUGH LENSES FOR MASSIVE 3D POINT CLOUDS

Soeren Discher, Rico Richter and Juergen Doellner

Hasso Plattner Institute, University of Potsdam, Germany

{soeren.discher, rico.richter, juergen.doellner}@hpi.uni-potsdam.de

Abstract 3D point clouds are a digital representation of our world and used in a variety of applications. They are captured with LiDAR or derived by image-matching approaches to get surface information of objects, e.g., indoor scenes, buildings, infrastructures, cities, and landscapes. We present novel interaction and visualization techniques for heterogeneous, time variant, and semantically rich 3D point clouds. Interactive and view-dependent see-through lenses are introduced as exploration tools to enhance recognition of objects, semantics, and temporal changes within 3D point cloud depictions. We also develop filtering and highlighting techniques that are used to dissolve occlusion to give context-specific insights. All techniques can be combined with an out-of-core real-time rendering system for massive 3D point clouds. We have evaluated the presented approach with 3D point clouds from different application domains. The results show the usability and how different visualization and exploration tasks can be improved for a variety of domain-specific applications.

Keywords: 3D point clouds, LiDAR, visualization, point-based rendering

REPRESENTATION OF CITYGML INSTANCE MODELS IN BASEX

Sabine Koch and Marc-Oliver Löwner

TU Berlin, Germany

sabine.koch87@gmail.com, m.loewner@tu-berlin.de

Abstract The Open Geospatial Consortium standard CityGML is an application schema of GML 3.1.1 for the representation storage and exchange of semantic-rich virtual 3D city models. Here, we assess the feasibility of storing, querying and updating CityGML models in the native XML database system BaseX. The features and performance of BaseX are compared with the implementation of the 3DCityDatabase which stores CityGML models in a relational database system. The results show that BaseX is a fast, flexible and intuitive tool to store and query even large CityGML documents. Its main advantage is the schema-oblivious storage mechanism that allows schema changes without changes to the database layout and the fast import and semantic querying of CityGML models. Using the 3DCityDatabase to manage CityGML data on the other hand is a better choice when spatial analysis and integration with third party software are demanded.

Keywords: CityGML, 3D city models, Native XML databases, BaseX

INVESTIGATING SEMANTIC FUNCTIONALITY OF 3D GEOMETRY FOR LAND ADMINISTRATION

George Floros, Eva Tsiliakou, Dimitrios Kitsakis, Ioannis Pispidikis and Efi Dimopoulou

National Technical University of Athens, Greece

f__giorgio@hotmail.com, eva.tsiliakos@gmail.com, dimskit@yahoo.gr, pispidikisj@yahoo.gr, efi@survey.ntua.gr

Abstract Significance of semantic data during the recent years is growing. This trend, combined with facilitation of new 3D object modeling has led to semantically enriched 3D models, serving various applications where relations between objects' components and their environment need to be stored and presented. In the field of Land Administration, semantics can greatly contribute to optimize land management and land policies. Integration of semantics to 3D building models is currently achieved through two differently structured models: semantic-oriented CityGML and structural-oriented BIM/IFC. Integration of the semantic information of each model is still an object of intense research worldwide. In this pa-per, a 3D building model designed in SketchUp Pro software was transformed using FME software to a CityGML file; land use features were assigned to the model and attribute queries were executed in order to check the exported models' functionality in terms of semantics.

Keywords: 3D modelling, Land Use, Sketchup Pro, CityGML, attribute query

MANAGING VERSIONS AND HISTORY WITHIN SEMANTIC 3D CITY MODELS FOR THE NEXT GENERATION OF CITYGML

Kanishk Chaturvedi[1], Carl Stephen Smyth[2], Gilles Gesquière[3], Tatjana Kutzner[1] and Thomas H. Kolbe[1]

[1]TU Munich, Germany, [2]OpenSite Plan, USA,LIRIS, [3]Universite de Lyon, France

kanishk.chaturvedi@tum.de, steve@opensiteplan.org, gilles.gesquiere@liris.cnrs.fr, kutzner@tum.de, thomas.kolbe@tum.de

Abstract Semantic 3D city models describe city entities by objects with thematic and spatial attributes and their interrelationships. Today, more and more cities worldwide are representing their 3D city models according to the CityGML standard issued by the Open Geospatial Consortium (OGC). Various application areas of 3D city models such as urban planning or architecture require that authorities or stakeholders manage parallel alternative versions of city models and their evolution over time, which is currently not supported by the CityGML standard 2.0.

In this paper, we propose a concept and a data model extending CityGML by denoting versions of models or model elements as planning alternatives. We support transitions between these versions to manage history or evolution of the city models over time. This approach facilitates the interoperable integration and exchange of different versions of a 3D city model within one dataset, including a possibly complex history of a repository. Such an integrated dataset can be used by different software systems to visualize and work with all the versions. The versions and version transitions in our proposed data model are bi-temporal in nature. They are defined as separate feature types, which allow the users to manage versioning and to perform queries about versions using an OGC Web Feature Service. We apply this data model to a use case of planning concurrent versions and demonstrate it with example instance data. The concept is general in the sense that it can be directly applied to other GML-based application schemas including the European INSPIRE data themes and national standards for topography and cadasters like the British Ordnance Survey Mastermap or the German cadaster standard ALKIS.

Keywords: Semantic 3D city models, CityGML, Planning versions, History, City model lifecycle

PHOTOVOLTAIC POTENTIALITY ANALYSIS USING 3D CITY MODELS

Nazmul Alam1, Volker Coors[1], Sisi Zlatanova[2] and Peter Van Oosterom[2]

[1]HFT Stuttgart, Germany,

[2]TU Delft, The Netherlands

{nazmul.alam, volker.coors} @hft-stuttgart.de, {s.zlatanova, p.j.m.vanOosterom} @tudelft.nl

Abstract Photovoltaic technology is very popular for generating electrical power now a days. Its energy transformation depends on solar radiation on that location and orientation. Shadow rapidly decreases performance of the Photovoltaic system. In this research, it is being investigated that how exactly real-time shadow can be detected and solar radiation incident upon a surface can be calculated. In principle, 3D city models containing roof structure, vegetation, thematically differentiated surface and texture, are suitable to simulate exact real-time shadow. An automated procedure to measure exact solar radiation from the 3D city models and a long-term simulation model to determine the produced energy from the photovoltaic system is being developed here. In this paper, a method for calculating solar radiation has been discussed with its result using a 3D city model to perform a photovoltaic potentiality analysis.

Keywords: Solar Energy, Shadow, 3D City Models, Photovoltaic Potentiality, CityGML

RECONSTRUCTING 3D BUILDING MODELS WITH THE 2D CADASTRE FOR SEMANTIC ENHANCEMENT

Frédéric Pedrinis and Gilles Gesquière

LIRIS, University of Lyon, France

{frederic.pedrinis, gilles.gesquiere} @liris.cnrs.fr

Abstract Virtual city models are increasingly used in urban land management processes, which involve the use of different sources of spatial information. This heterogeneous data is, however, often complementary and it may be necessary to give the possibility to join information provided by different sources. This paper presents a method to enhance 3D buildings by using usual 2D vectorial polygon database. These polygons may represent districts, building footprints, or any segmentation of the urban area that adds information to the city model. The enhancement consists in using this polygon database to split the 3D buildings into a set of city objects where each element possesses a 3D geometry and the semantic information of the polygon it is linked to. In this paper, for an illustration purpose, we will present how to create this link between 3D buildings and the cadastre map, in order to create a set of semantically rich 3D building models.

Keywords:3D Virtual City, Cadastre, CityGML, Semantic information

REPRESENTATION OF CITYGML INSTANCE MODELS IN BASEX

Sabine Koch[1], Marc-O. Löwner[2]

[1] Technische Universität Berlin

[2] Departement Methods of Geoinformation Science, Technische Universität Berlin

m.loewner@tu-berlin.de,Sabine.koch@posteo.de

Abstract The Open Geospatial Consortium standard CityGML is an application schema of GML 3.1.1 for the representation, storage and exchange of semantic-rich virtual 3D city models. Here we assess the feasibility of storing, querying and updating CityGML models in the native XML database system BaseX. The features and performance of BaseX are compared with the implementation of the 3DCityDatabase which stores CityGML models in a relational database system. The results show that BaseX is a fast, flexible and intuitive tool to store and query even large CityGML documents. Its main advantage is the schema-oblivious storage mechanism that allows schema changes without changes to the database layout and the fast import and export of CityGML models. Using the 3DCityDatabase to manage CityGML data on the other hand is a better choice when spatial analysis and integration with third party software are demanded.

Keywords: CityGML · 3D city models · Native XML databases · BaseX

REVIEW AND ASSESSMENT OF CURRENT CADASTRAL DATA MODELS FOR 3D CADASTRAL APPLICATIONS

Ali Aien, Abbas Rajabifard, Mohsen Kalantari, and Ian Williamson

University of Melbourne,Australia

{aiena, abbas.r, mohsen.kalantari, ianpw}@unimelb.edu.au

Abstract Three-dimensional (3D) cadastres are often described as the 3D digital representation of real property rights, restrictions, and responsibilities (legal objects). They can also contain physical counterparts (physical objects) of legal objects such as buildings and utility networks, on, above or under the surface. Implementation of 3D cadastres requires many elements such as existing 3D property registration laws, appropriate 3D data acquisition methods, 3D spatial database management systems, and functional 3D visualisation platforms. In addition, an appropriate 3D cadastral data model can also play a key role to ensure successful development of the 3D cadastre. Many jurisdictions have defined their own cadastral data models. However, none of them can fully support the requirements of 3D cadastres. This paper aims to explore the theories and concepts of the most common existing cadastral data models and investigate how they manage 3D legal and physical data. The result of this research can be used by cadastral data modellers to improve existing or develop new cadastral data models to support the requirements of 3D cadastres.

Keywords: cadastral data model, land administration, core cadastral data model, e-plan model, basic administrative unit

STOCHASTIC BUILDINGS GENERATION TO ASSIST IN THE DESIGN OF RIGHT TO BUILD PLANS

Mickaël Brasebin[1], Julien Perret[2] and Romain Reuillon[3]

[1]Laboratoire Cogit, France,[2]IGN, France,[3]Institut des Systèmes Complexes Paris Ile-de-France

mickael.brasebin@ign.fr, julien.perret@gmail.com, romain.reuillon@iscpif.fr

Abstract The design of documents impacting potential new constructions, such as Right to Build plans, is a complex issue. New tools need to be proposed in order to systematically assess the impact of regulations on the built potential of the concerned areas. Furthermore, it is often not directly the morphology of new constructions that administrations and citizens would like to regulate but their properties with regard to other phenomena (solar energy potential, etc.). In order to tackle these issues, we propose in this article to explore building configurations and regulations using a stochastic building generator and a workflow engine. The workflow we propose for such an exploration will produce important amounts of data that we intend to release as OpenData in order for administrations, urban planners and citizens to be able to freely visualize and collectively choose the regulations that best suit their territory. Such amounts of 3D geographical data also suggests new issues in geo visualization.

Keywords: 3D GIS, urban regulation, design, optimization

TEMPORAL AND SPATIAL DATABASE SUPPORT FOR GEOTHERMAL SUB-SURFACE APPLICATIONS

Markus Jahn[1], Martin Breunig[1], Edgar Butwilowski[1], Paul Kuper[1], Andreas Thomsen[1], Eva Schill[2] and Mulhim Al- Doori[3]

[1]Geodetic Institute, Karlsruhe Institute of Technology, Germany

[2]Institute of Nuclear Waste Disposal, Karlsruhe Institute of Technology, Germany

[3]School of Engineering, American University in Dubai, UAE

{markus.jahn, martin.breunig, edgar.butwilowski, paul.kuper, andreas.thomsen, eva.schill}@kit.edu, maldoori@aud.edu

Abstract Geothermal energy production from the deep subsurface requires a detailed knowledge of the relevant static and transient parameter distribution in the reservoir and host rock. In reservoir exploration, engineering and operation phases, both temporal and spatial subsurface parameters are acquired, evaluated and monitored in order to improve the reservoir performance. To support temporal and spatial data access to geothermal data sources, an efficient 3D/4D GIS is proposed in this study. We discuss theoretical and first practical approaches for the management of such temporal and spatial geothermal data. A first practical example is provided using the data acquired in the Soultz-sous-Forets geothermal project (France). A distributed software architecture, database design, and the concept for advanced query component with embedded simulations are presented. Finally, we give an outlook on the planned future research in 3D data management of subsurface, near-surface, and above-surface installations in other projects.

Keywords: temporal database, spatial database, 3D database, 3D/4D database, 3D/4D GIS, geothermal application, sub-surface application

THE HIERARCHICAL THREE-DIMENSIONAL (3D) DYNAMIC WATER INFILTRATION ON MULTILAYERS OF SOIL ACCORDING TO VORONOI SEQUENCE NODES BASED ON THE THREE-DIMENSIONAL TRIANGULAR IRREGULAR NETWORK (3D TIN)

Siti Nurbaidzuri Reli, Izham Mohammad Yusoff, Habibah Lateh and Uznir Ujang

Pusat Pengajian Pendidikan Jarak Jauh, Universiti Sains Malaysia, Penang,Malaysia
baidzuri88@gmail.com, izham.usm@gmail.com, habibah@usm.my, mduznir@utm.my

Abstract Understanding soil water infiltration movement has been birthed from extensive interest and concern in the last few decades. The arrangement of particles (i.e. structures and sizes) and the interaction between both the soil and soil water have a profound effect on the soil water infiltration. The challenging task in the soil fluid modelling is the indeterminate spatial extent that has no specific boundaries and the fact that it is difficult to sense. Plenty of investigations and studies have been conducted to measure the water movement. However, less focus has been given on the movement of the dynamic soil water infiltration. This paper will focus on modelling the three-dimensional (3D) soil water infiltrations that flow downward due to the gravitational factor and gradient pressure. The 3D hierarchical soil water infiltration model proposes the integration of techniques which includes the Tree-map to isolate the depth of the soil that acts as a route of the soil water flow from the surface of the terrain to the sub-surface flow. Moreover, the 3D Gosper curve is used to represent the soil water flow pattern that is based on the law of gravity and Horton equation, which control the flow of the soil water in the model. The curves that consist of a series of nodes adopt the Three-Dimensional Triangular Irregular Network (3D TIN) which creates a network of flow direction that allows the water to pass through the nodes according to a predetermined sequence. The study area has an average of 8.5 mm total rain and -5 meter water level. The soil is divided into a few layers to represent the flow of the soil water according to the sequence of nodes. The soil depth (40 cm, 80 cm, 120 cm, 160 cm and 200 cm) isolation in the form of Voronoi-shaped polygon nodes allows the soil water to flow down where the depth is chosen based on the soil wetting range of the subsurface soil.

Keywords: Soil Water, Infiltration, Three-Dimensional (3D), Fluid Modelling

THE POTENTIAL OF THE 3D DUAL HALF- EDGE (DHE) DATA STRUCTURE FOR INTEGRATED 2D-SPACE AND SCALE MODELLING: A REVIEW

Wan Muhd Hairi Wan Ab Karim[1], Alias Abdul Rahman[1], Pawel Boguslawski[2], Martijn Meijers[3] and Peter Van Oosterom[3]

[1]Department of Goeinformation, Universiti Teknologi Malaysia

[2]UWE, UK

[3]TU Delft, The Netherlands

wmhairigis@gmail.com,alias@utm.my, pboguslawski@gmail.com, b.m.meijers@tudelft.nl, p.j.m.vanoosterom@tudelft.nl

Abstract Scaling factor is one of the most crucial aspect in 2D and 3D models especially in computer graphics, CAD, GIS, and games. Different user or/and application need different scale models during various stages of the use of data, including visualization and interaction. There are some arisen issues on 3D data model especially to meet GIS requirements while minimize the redundancy of the datasets. In GIS modelling, various data structures and data models have been proposed to support variety of applications and dimensionalities, but only a few in scale dimension. Some of them have succeeded in modelling scale such as in Space-Scale Cube (SSC) model. The recently implemented Dual Half-Edge (DHE) data structure within the PostgreSQL database is suitable for any valid 3D spatial model; not yet being explored for other dimensional such as scale environment. Using the same vario-scale approach, the DHE data model is also capable to implement a variable Level of Detail (LoD) representation such as SSC model. Some advantages of the DHE are described in this paper such as the dynamic property (valid updates based on Euler operations) and topology approach in comparison with other existing data structures. The last section of this paper de-scribes capability of the DHE data structure to provide a better platform for GIS integrated space-scale data model.

Keywords: scale dimension, data structures, spatial models, Level of Details

TOWARDS INTEGRATING BIM AND GIS - AN END-TO-END EXAMPLE FROM POINT CLOUD TO ANALYSIS

Claire Ellul and Gareth Boyes

Dept. of Civil, Environmental and Geomatic Engineering, University College London, UK
{c.ellul, gareth.boyes.13} @ucl.ac.uk

Abstract Building Information Modelling (BIM) is becoming increasingly important within the UK, not least because of a UK Government directive that mandates Level 2 BIM for companies tendering for Government work, with the aim of reducing the cost of construction of public assets by 20-30\%. While this is aimed at new construction, it can be foreseen that a wider introduction of BIM could also result in savings during large refurbishment projects, which form a significant part of construction work in the UK. However, unlike new projects, where the model for the BIM can be obtained from CAD drawings, deriving the BIM for pre-existing structures requires some form of scan-to-BIM operation using laser scanning. To contribute to sustainability in construction, an underlying driver for BIM, the BIM must also be integrated with other data sources. Therefore, once the scan is complete, the resulting point cloud must be converted into geometry objects and geo-referenced for integration with Geographical data such as air quality or noise information. This paper presents an end-to-end example of this process, focusing in particular on the challenges of integrating BIM and GIS into one framework, and highlighting the steps to be carried out during BIM creation in order to enable this to take place.

USABILITY ASSESSMENT OF A VIRTUAL GLOBE-BASED 4D ARCHAEOLOGICAL GIS

Berdien De Roo, Jean Bourgeois and Philippe De Maeyer

Department of Geography, University of Ghent, Belgium
{berdien.deroo, jean.bourgeois, philippe.demaeyer}@u-gent.be

Abstract Acquired using 3D technologies, archaeological data is increasingly represented via 3D visualizations. For analysing, interpreting and exchanging, these data are mostly reduced to two dimensions. Therefore, a 4D archaeological GIS that integrates 3D representations and analytical functionalities will contribute to different parts of the archaeological workflow from fieldwork preparation over analysis to reporting. Such a 4D approach will facilitate better and more integrated insights and allow more complex analyses and interpretations. Incorporating such a 4D archaeological GIS in a web-based environment will even increase the benefits as this could function as a virtual workspace. Since virtual globes have proven their capabilities to manage and visualize 3D data in non-expert applications, a proto-typical 4D archaeological GIS was developed based on the virtual globe Cesium. This paper demonstrates by means of a usability test with employees of a Flemish archaeological organization that the concept of such a low-threshold application is supported by the intended end-users. Although some usability problems were encountered and the functionalities of the prototype are rather limited, extending and further developing the system could result in a valuable research tool for archaeology.

Keywords:4D GIS, archaeology, virtual globes usability

WEB-BASED TOOL FOR THE SUSTAINABLE REFURBISHMENT IN HISTORIC DISTRICTS BASED ON 3D CITY MODEL

Iñaki Prieto, Jose Luis Izkara and Rubén Béjar

TECNALIA, Universidad de Zaragoza, Spain

Abstract The objective of this article is to describe a web-based tool that aims the management and conservation of urban heritage by means of the usage of a decision making system. The decision making system will be feed by a 3D city model of a historic district, enabling the storage and presentation of data at city and building scales. 3D city model contains both geometric and semantic data into a single data model. Access to stored city objects in the 3D city model is made through standard web services defined by the Open Geospatial Consortium (OGC). The presentation of the information is performed through an user friendly interface based on the interactive representation of the 3D city model using Web3D technologies (HTML5 and WebGL)

Keywords:3D city models, CityGML, Sustainable refurbishment, Historic districts

EXTENDED ABSTRACTS

3-DIMENSIONAL GEOLOGICAL MAPPING AND MODELING ACTIVITIES AT THE GEOLOGICAL SURVEY OF NORWAY

Alexandra Jarna, Ane Bang-Kittilsen,Claudia Haase, Iain Henderson, Fredrik Høgaas, Sverre Iversen and Anna Seither

Norges geologiske undersøkelse (Geological Survey of Norway), Trondheim, Norway
alexandra.jarna@ngu.no

Abstract Geology and all geological structures are three-dimensional in space. Geology can be easily shown as four-dimensional when time is considered. Therefore GIS, databases, and 3D visualization software are common tools used by geoscientists to view, analyse, create models, interpret and communicate geological data. The NGU (Geological Survey of Norway) is the national institution for the study of bedrock, mineral resources, surficial deposits and groundwater and marine geology. The interest in 3D mapping and modelling has been reflected by the increase of number of groups and researches dealing with 3D in geology within NGU. This paper highlights 3D geological modelling techniques and the usage of these tools in bedrock, geophysics, urban and groundwater studies at NGU, same as visualisation of 3D online. The examples show use of a wide range of data, methods, software and an increased focus on interpretation and communication of geology in 3D. The goal is to gradually expand the geospatial data infrastructure to include 3D data at the same level as 2D.

Keywords: 3D geology, Geometric modelling, Boreholes, DTM, Geological maps, LiDAR, Geophysics, Urban geology, 3D subsurface modelling

A REVIEW OF MULTI-HAZARD RISK ASSESSMENT (MHRA) USING 4D DYNAMIC MODELS

Tehmina Bibi and Alias Abdul Rahman

Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor, Malaysia
ehmina_khan79pk@hotmail.com, alias@utm.my

Abstract This paper reviews the 4D dynamic models for multi-hazard risk assessment. It is important to review the characteristic of the different dynamic models and to choose the most suitable model for certain application. The characteristic of the different 4D dynamic models are based on several main aspects (e.g. space, time, event or phenomenon etc). The most suitable 4D dynamic model depends on the type of application it is used for. There is no single 4D Dynamic model suitable for all types of application. Therefore, it is very important to define the requirements of the 4D Dynamic model. The main context of this paper is spatio temporal modelling for multi hazards.

Keywords: Multi-hazard, Risk assessment, Three-dimensional, Dynamic phenomenon's, 4D dynamic models

A STUDY ON THE IMPROVEMENT OF CADASTRAL SYSTEM IN MONGOLIA - FOCUSED ON NATIONAL LAND INFORMATION SYSTEM

Munkhbaatar Buuveibaatar and Jiyeong Lee

University of Seoul, Seoul, Korea

baataraa1@naver.com, jlee@uos.ac.kr

Abstract National land information system (NLIS) is an essential part of the Mongolian land reform. NLIS is a web based and centralized system which covers administration of cadastral database all over the country among land departments. Current ongoing NLIS implementation is vital to improve the cadastral system in Mongolia. This study is intended to define existing problems in current Mongolian cadastral system and propose administrative institutional and systematic implementation through NLIS. Once NLIS launches with proposed model of comprehensive cadastral system it will lead to not only economic and sustainable development but also contribute to citizens' satisfaction and lessen the burdensomeness of bureaucracy. Moreover, prevention of land conflicts, especially in metropolitan area as well as gathering land tax and fees. Furthermore after establishment of NLIS, it is advisable that connecting NLIS to other relevant state administrational organizations or institutions that have relevant database system. Connections with other relevant organizations will facilitate not only smooth and productive workflow but also offer reliable and more valuable information by its systemic integration with NLIS.

Keywords: Cadastre, NLIS, Mongolia

A WALKING DISTURBANCE INDEX SUGGESTIONS FOR OPTIMIZED PATH SEARCH FOR THE TRANSPORTATION VULNERABLE (EXTENDED ABSTRACT)

Mikyeong Moon, Yoonsik Bang, Kiyun Yu and Jiyoung Kim

Seoul National University, Korea

{coco0320, bangys1004, kiyun, soodaq} @snu.ac.kr

Abstract Recently, due to the increased penetration of smart devices and the development of geographic information system (GIS) technology, various route guidance services for pedestrians have been developed. However, until now, pedestrian navigation services for the transportation vulnerable (people who experience discomfort in transportation) including wheelchair users, the elderly, and pregnant women have not been provided. In this study, we present a walking disturbance index methodology for searching an optimized path for the transportation vulnerable by defining the factors that affect the walking of the transportation vulnerable and deriving the weights of these factors. In future research, we expect to be able to provide a navigation system that gives an optimized path for the transportation vulnerable using this method.

Keywords: AHP, fuzzy logic, optimized path for the transportation vulnerable

AN OVERVIEW OF 3D TOPOLOGY FOR LADM-BASED OBJECTS (EXTENDED ABSTRACT)

Nur Amalina Zulkifli and Alias Abdul Rahman

Department of Geoinformation, Universiti Teknologi Malaysia, Johor, Malaysia

ina_syada85@yahoo.com, alias@utm.my

Abstract This paper reviews 3D topology within LADM standard. It is important to review characteristic of the different 3D topological models and to choose the most suitable model for certain applications. The characteristic of the different 3D topological models are based on several main aspects (e.g. space or plane partition, used primitives, constructive rules, orientation and explicit or implicit relationships). The most suitable 3D topological model depends on the type of application it is used for. There is no single 3D topology model suitable for all types of application. Therefore, it is very important to define the requirements of the 3D topology model. The context of this paper is a 3D topology for LADM-based objects.

Keywords: 3D topology, LADM, 3D cadastre, TEN

ANALYSE THE IMPACT OF HABITAT PATCHES ON WILDLIFE ROAD-KILL

S. Seok and J. Lee

Dept. of Geoinformatics, The University of Seoul, 163 Seoulsiripdaero, Seoul, South Korea (rltk00, jlee@uos.ac.kr)

Abstract The ecosystem fragmentation due to transportation infrastructure causes a road-kill phenomenon. When making policies for mitigating road-kill it is important to select target-species in order to enhance its efficiency. However, many wildlife crossing structures have been questioned regarding their effectiveness due to lack of considerations such as target-species selection, site selection, management, etc. The purpose of this study is to analyse the impact of habitat patches on wildlife road-kill and to suggest that spatial location of habitat patches should be considered as one of the important factors when making policies for mitigating road-kill. Habitat patches were presumed from habitat variables and a suitability index on target-species that was chosen by literature review. The road-kill hotspot was calculated using Getis-Ord Gi*. After that, we performed a correlation analysis between Gi Z-score and the distance from habitat patches to the roads. As a result, there is a low negative correlation between two variables and it increases the Gi Z-score if the habitat patches and the roads become closer.

Keywords: Road-kill, Correlation analysis, Habitat Patches, Hotspots

AREAL FEATURE MATCHING BASED ON SIMILARITY USING CRITIC METHOD

Jiyoung Kim[a]*, Kiyun Yu[b]

[a] Institute of Construction and Environmental Engineering, Seoul National University, Ganak-ro 1, Seoul, Korea - soodaq@snu.ac.kr, [b] Dept. of Civil & Environmental Engineering, Seoul National University, Ganak-ro 1, Seoul, Korea - kiyun@snu.ac.uk

Abstract In this paper, we propose an areal feature matching method that can be applied for many-to-many matching, which involves matching a simple entity with an aggregate of several polygons or two aggregates of several polygons with fewer user intervention. To this end, an affine transformation is applied to two datasets by using polygon pairs for which the building name is the same. Then, two datasets are overlaid with intersected polygon pairs that are selected as candidate matching pairs. If many polygons intersect at this time, we calculate the inclusion function between such polygons. When the value is more than 0.4, many of the polygons are aggregated as single polygons by using a convex hull. Finally, the shape similarity is calculated between the candidate pairs according to the linear sum of the weights computed in CRITIC method and the position similarity, shape ratio similarity, and overlap similarity. The candidate pairs for which the value of the shape similarity is more than 0.7 are determined as matching pairs. We applied the method to two geospatial datasets: the digital topographic map and the KAIS map in South Korea. As a result, the visual evaluation showed two polygons that had been well detected by using the proposed method. The statistical evaluation indicates that the proposed method is accurate when using our test dataset with a high F-measure of 0.91.

Keywords: Areal Feature Matching, Multi Criteria Decision Analysis, CRITIC, F-measure, Confusion

DEVELOPING A METHOD TO GENERATE INDOORGML DATA FROM THE OMNI-DIRECTIONAL IMAGE

Munsu Kim and Jiyeong Lee

Department of Geoinformatics, The University of Seoul, rlaanstn01@gmail.com, jlee@uos.ac.kr

Abstract Recently, many applications for indoor space are developed. The most realistic way to service an indoor space application is on the omni-directional image so far. Due to limitations of positioning technology and indoor space modelling, however, indoor navigation service can't be implemented properly. In 2014, IndoorGML is approved as an OGC's standard. This is an indoor space data model which is for the indoor navigation service. Nevertheless, the IndoorGML is defined, there is no method to generate the IndoorGML data except manually. This paper is aimed to propose a method to generate the IndoorGML data from the omni-directional image. In this paper, image segmentation and classification method are adopted to generate the IndoorGML data. The edge detection method is used to extract the features from the image. After doing the edge detection method, image classification method with ROI is adopted to find the features that we want. The following step is to convert the extracted area to the point which is regarded as state and connect to shooting point's state. This is the IndoorGML data at the shooting point. It can be expanded to the floor's IndoorGML data by connecting the each shooting points after repeating the process. Also, IndoorGML data of building can be generated by connecting the floor's IndoorGML data. The proposed method is adopted at the testbed, and the IndoorGML data is generated. By using the generated IndoorGML data, it can be applied to the various applications for indoor space information service.

Keywords: IndoorGML, Omni-directional Image, Topological Data, Edge Detection, Image, Classification, Region of Interest

GEOINFORMATION POSTGRADUATE EDUCATION AT UNIVERSITI TEKNOLOGI MALAYSIA - TOWARDS A CENTRE OF HIGH QUALITY POSTGRADUATE EDUCATION AND RESEARCH

Stefan Peters, Kasturi Devi Kanniah and Alias Abdul Rahman

Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor Bahru, Malaysia,

stefan.peters@directbox.com, kasturikanniah12@gmail.com, alias@utm.my

Abstract Studying at Universiti Teknologi Malaysia (UTM) will ensure academic and technological excellence. The Faculty of Geoinformation and Real Estate (FGHT), established in 1972, focus on education and research for undergraduate as well as postgraduate programs in the related disciplines such as geomatic engineering, geoinformatics, remote sensing, property management and land administration & development. FGHT strives to be a leading academic center in geoinformation and real estate in Southeast Asia. Graduates and alumni form major strong professional societies and work force in the related industries. Many of our graduates end up with good jobs not just in Malaysia but also in other countries (Asian, Middle East, Africa and Europe). The strong team and knowledgeable academic members in this faculty provide excellent ingredients for the success of the programs (i.e. with the relevant and up-to-date curriculum and syllabus). FGHT is continuously working to provide and offer first-class geoinformation and real estate education and research in the country and be at a par with other leading institutions in other parts of the globe. The Department of Geoinformation at FGHT runs a Bachelor of Engineering in Geomatic and a Bachelor of Science in Geoinformatics. At the postgraduate levels, namely M.Sc. and PhD programs, the offered disciplines are Geomatic Engineering, Geoinformatics and Remote Sensing. In the following, the state of the art of FGHT's postgraduate education in Geoinformation is presented, including a comparison with other universities in Malaysia, program content and curriculum information, alumni statistics as well as future strategies.

Keywords: Postgraduate education, Geoinformation, UTM, Malaysia

GIS FOR PREDICTING THE AVALANCHE ZONES IN THE MOUNTAIN REGIONS OF KAZAKHSTAN

Zh. T. Omirzhanova[1]*, A. S. Urazaliev[1], A.T. Aimenov[2]

[1] Department Geodesy and Cartography, International Educational Corporation, Ryskulbekova, 28, Almaty, Kazakhstan- omirzhanova.kazgasa@gmail.com, aset.urazaliev@mail.ru

[2] National Cartographical and Geodesic foundation, Esenberlina 36, Almaty, Kazakhstan - digitalmap@list.ru

Abstract Foothills of Trans Ili Alatau is a recreational area with buildings and sports facilities and resorts, sanatoriums, etc. In summer and winter there are a very large number of skiers, climbers, tourists and workers of organizations which located in the mountains. In this regard, forecasting natural destructive phenomena using GIS software is an important task of many scientific fields. The formation of avalanches, except meteorological conditions, such as temperature, wind speed, snow thickness, especially affecting mountainous terrain. Great importance in the formation of avalanches play steepness (slope) of the slope and exposure. If steep slopes contribute to the accumulation of snow in some places, increase the risk of flooding of the slope, the various irregularities can delay an avalanche. According to statistics, the bulk of the avalanche is formed on the slopes steeper than 30°. In the course of research a 3D model of the terrain was created with the help of programs ArcGIS and Surfer. Identified areas with steep slopes, the exposure is made to the cardinal. For dangerous terrain location is divided into three groups: favorable zone, danger zone and the zone of increased risk. The range of deviations from 30-45° is dangerous, since the angle of inclination of more than 30°, there is a maximum thickness of sliding snow, water, the upper layer of the surface and there is an increase rate of moving array, and the mountain slopes at an angle 45^0 above are the area increased risk. Created on DTM data are also plotted Weather Service for the winter of current year. The resulting model allows to get information upon request and display it on map base, assess the condition of the terrain by avalanches, as well as to solve the problem of life safety in mountainous areas, to develop measures to prevent emergency situations and prevent human losses.

Keywords: Geographic Information System, a Digital Terrain Model, Slope, Steep slopes, Avalanche zone

GROUPING METHOD FOR NEIGHBOR OBJECTS OF MOVING OBJECT USING HASH INDEX (EXTENDED ABSTRACT)

Baesung Lee, Jiyoung Kim and Kiyun Yu

Seoul National University, Seoul, Korea

{aimhigh1101, soodaq, kiyun} @snu.ac.kr

Abstract A location-based social network (LBSNS) is a social network service (SNS) that is based on a user's location, unlike SNS, and facilitates additional activities like neighbour-user search and group formation in real time. This research examined the efficiency of a real-time grouping method for extracted neighbour objects on a WMTS (Web Map Tile Service) for which a hash index was used. As a result, the suggested method is not different from buffering a neighbour area according to the average number of returned data per 1 km2, and the required time is shorter than that of buffering.

Keywords: Grouping method, moving object, hash index

INDOOR SUBSPACING TO IMPLEMENT INDOORGML FOR INDOOR NAVIGATION

H. Jung and J. Lee

Dept. of Geoinformatics, The University of Seoul, 163 Seoulsiripdaero, Seoul, Korea (hyojin5919, jlee)@uos.ac.kr

Abstract According to an increasing demand for indoor navigation, there are great attempts to develop applicable indoor network. Representation for a room as a node is not sufficient to apply complex and large buildings. As OGC established IndoorGML, subspacing to partition the space for constructing logical network is introduced. Concerning subspacing for indoor network, transition space like halls or corridors also have to be considered. This study presents the subspacing process for creating an indoor network in shopping mall. Furthermore, categorization of transition space is performed and subspacing of this space is considered. Hall and squares in mall is especially defined for subspacing. Finally, implementation of subspacing process for indoor network is presented.

Keywords: Subspacing, Indoor Space, Indoor Navigation, IndoorGML

KINGDOM OF SAUDI ARABIA GEOSPATIAL INFORMATION INFRASTRUCTURE – AN INITIAL STUDY

Sultan H. Alsultan[a] and Alias Abdul Rahman[b]

[a]College of Agriculture and Veterinary Medicine, Qaseem University, Buraydah 52571, Saudi Arabia. - comput321@gmail.com

[b]GII Research Group, Department of Geoinformatic, Faculty of Geoinformatic and Real Estate, Universiti Teknologi Malaysia Johor Bahru, Malaysia. - alias@utm.my

Abstract: This paper reviews the current Geographic Information System (Longley et al.) implementation and status in the Kingdom of Saudi Arabia (KSA). Based on the review, several problems were identified and discussed. The characteristic of these problems show that the country needs a national geospatial centre. As a new initiative for a national geospatial centre, a study is being conducted especially on best practice from other countries, availability of national committee for standards and policies on data sharing, and the best proposed organization structure inside the administration for the KSA. The study also covers the degree of readiness and awareness among the main GIS stakeholders within the country as well as private parties. At the end of this paper, strategic steps for the national geospatial management centre were proposed as the initial output of the study.

Keywords: National geospatial centre, National standards and policies, National initiative, Strategic plan

MULTI-PLATFORM SATELLITE BASED ESTIMATES OF RUNOFF IN UNGAUGED AREAS (EXTENDED ABSTRACT)

Jae Young Seo and Sang-Il Lee

Dongguk University, Seoul, Korea

dabbi2011@naver.com, islee@dongguk.edu

Abstract Over the past decades, extreme weather events such as floods and droughts have been on a steady increase. Especially, ungauged or hard-to-reach areas turn out to be the most affected areas by the unexpected water-related disasters. It is usually due to insufficient observation data, and deterioration of infra-structures as well as inadequate water management system. For such reasons, reliable estimation of runoff is important for the planning and the implementation of water projects in ungauged areas. North Korea, whose terrain is mostly hilly and mountainous, has become vulnerable to floods and droughts due to poor watershed management based on unreliable hydrological information along with rapid deforestation. Runoff estimation using data from multiple satellites having broad spatio-temporal coverage could be of a valuable substitute for ground-observed measurements. In this study, we estimate monthly runoff in North Korea by combining space-borne data from multiple satellites with ground observations. Period of analysis is from January 2003 to December 2013. Data sets used for this study are as in the following: (1) Terrestrial Water Storage Anomaly (TWSA) from Gravity Recovery and Climate Experiment (GRACE), (2) Evapotranspiration from Moderate Resolution Imaging Spectroradiometer (MODIS), (3) Satellite-observed precipitation from Tropical Rainfall Measurement Mission (TRMM), and (4) Ground-observed precipitation from World Meterological Organization (WMO). These components are balanced with the terrestrial water storage change, and runoff can be estimated from mass balance. Upscaling methods were used to integrate the various spatial and temporal scales of each dataset. We estimated runoff time series during the study period and compared the results with those of four land surface models (CLM, Noah, Mosaic, and VIC) in GLDAS (Global Land Data Assimilation System). Results show a good agreement in seasonal pattern between two time series. It indicates that there is sufficient reliability in combining multiple satellite measurements with ground observation data. Currently, baseflow estimation is under way. By extracting the baseflow from total runoff, surface runoff which accounts for the flow regime in an area is expected to be obtained.

Keywords: Ungauged areas, Long-term runoff, Multi-platform satellite, GLDAS

NON-TERRAIN FEATURES FILTERING BY INTEGRATING GEOMETRICAL AND SPECTRAL INFORMATION

C. L. Lau[a], S. Halim[a], M. Zulkepli[a], A. Mohd Azwan[b] , W. L. Tang[a], A. K. Chong[c]

[a]Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, UTM Skudai, Malaysia – lauchongluh@gmail.com, halim@utm.my, drzulmajid@gmail.com, renoald@live.com

[b]Department of Surveying Science and Geomatic, Faculty of Architecture, Planning and Surveying, Universiti Teknologi Mara (Perlis), Malaysia – mohdazwan@perlis.uitm.edu.my

[c]School of Civil Engineering and Surveying, University of Southern Queensland, Australia – chonga@usq.edu.au

Abstract The extraction of true terrain points from unstructured laser point cloud data is an important process in order to produce an accurate digital terrain model (DTM). However, most of these spatial filtering methods just utilizing the geometrical data to discriminate the terrain points from nonterrain points. The point cloud filtering method also can be improved by using the spectral information available with some scanners. Therefore, the objective of this study is to investigate the effectiveness of using the three-channel (red, green and blue) of the colour image captured from built-in digital camera which is available in some Terrestrial Laser Scanner (TLS) for terrain extraction. In this study, the data acquisition was conducted at a mini replica landscape in Universiti Teknologi Malaysia (UTM), Skudai campus using Leica ScanStation C10. The spectral information of the coloured point clouds from selected sample classes are extracted for spectral analysis. The coloured point clouds which within the corresponding preset spectral threshold are identified as that specific feature point from the dataset. This process of terrain extraction is done through using developed Matlab coding. Result demonstrates that a higher spectral resolution passive image is required in order to improve the output. This is because low quality of the colour images captured by the sensor contributes to the low separability in spectral reflectance. In conclusion, this study shows that, spectral information is capable to be used as a parameter for terrain extraction.

Keywords: Terrestrial Laser Scanner, Colour Image, Spectral Information, Integration, Terrain, Extraction

OCEAN WAVE ENERGY ESTIMATION USING ACTIVE SATELLITE IMAGERY AS A SOLUTION OF ENERGY SCARCE IN INDONESIA CASE STUDY: POTERAN ISLAND'S WATER, MADURA (EXTENDED ABSTRACT)

Zulfikar Adlan Nadzir[a], Loryena Ayu Karondia[a], Lalu Muhamad Jaelani[a], Albertus Sulaiman[b], Adjie Pamungkas[b], Eddy Setyo Koenhardono[c] and Aries Sulisetyono[d]

[a] Dept. of Geomatics Engineering, Faculty of Civil Engineering and Planning,
[b] Dept. of Urban and Regional Planning, Faculty of Civil Engineering and Planning,
[c] Dept. of Marine Engineering, Faculty of Marine Technology,
[d] Dept. of Naval Architecture and Shipbuilding Engineering, Faculty of Marine Technology,
Institut Teknologi Sepuluh Nopember, Surabaya, 60111, Indonesia.
zulfikar11@mhs.geodesy.its.ac.id; ayu.karondia11@mhs.geodesy.its.ac.id;
lmjaelani@geodesy.its.ac.id; adjie@urplan.its.ac.id; eddy-koen@its.ac.id;
sulisea@na.its.ac.id
[e] Center of Technology for Natural Resources Inventory, Agency for the Assessment and Application of Technology
albertus.sulaiman@bppt.go.id

Abstract Ocean wave energy is one of the Ocean Renewable Energies which become Indonesia's archipelago maritime potential, in which these energy has several advantages over fossil energy and being one of the most researched energy nowadays, especially in developed countries. One of the effort of mapping ORE potential, especially ocean wave energy was done by computing energy which can be generated from ocean wave, symbolized with Watt per area unit using various method of observation. SAR (Synthetic Aperture Radar) is one of the hype and most developed Remote Sensing method which can be used to monitor and map the ocean wave energy potential effectively and fast. SAR imagery processing can be done not only in remote sensing data application only, but also using Matrices processing application such as Matlab by utilizing Fast Fourier Transform and Band-Pass Filtering methods after getting through Pre-Processing part. In this research, an estimation and processing of ALOS-PALSAR satellite imagery with acquisition time of 5/12/2009 was done in 2 methods, which resulted in 9 potential location of ocean wave energy generation, ranged between 0-228 W/m2, and 7 potential location with ranged values between 182-1317 W/m2. After getting through buffering process with value of 2 km, 9 site of potential location was estimated to be the most potential location of ocean wave energy generation.

Keywords: ALOS PALSAR, Matlab, Ocean Wave Energy, Poteran Island, FFT

RETRIEVAL OF SEA SURFACE TEMPERATURE OVER POTERAN ISLAND WATERS OF INDONESIA WITH LANDSAT 8 TIRS IMAGE: A PRELIMINARY ALGORITHM (EXTENDED ABSTRACT)

M. Aldila Syariz[1], Lalu Muhamad Jaelani[1], Luki Subehi[2], Adjie Pamungkas[3], Eddy Setyo Koenhardono[4] and Aries Sulisetyono[5]

[1]Dept. of Geomatics Engineering, Faculty of Civil Engineering and Planning, Institut Teknologi Sepuluh Nopember

[2]Research Centre for Limnology, Indonesian Institute of Sciences

[3]Dept. of Urban and Regional Planning, Faculty of Civil Engineering and Planning, Institut Teknologi Sepuluh Nopember

[4]Dept. of Marine Engineering, Faculty of Marine Technology, Institut Teknologi Sepuluh Nopember

[5]Dept. of Naval Architecture and Shipbuilding Engineering, Faculty of Marine Technology, Institut Teknologi Sepuluh Nopember

aldila.syariz11@mhs.geodesy.its.ac.id, lmjaelani@gmail.com, luki@limnologi.lipi.go.id, adjie@urplan.its.ac.id, eddy-koen@its.ac.id, sulisea@na.its.ac.id

Abstract The Sea Surface Temperature (SST) retrieval from satellites data has been available since 80's both temporally and spatially. Thus, it could provide SST data for a long time. Since, the algorithms of SST estimation by using Landsat 8 Thermal Band are limited, we need to develop an applicable algorithm in Indonesian waters. The aim of this research was to develop SST algorithms in the North Java Island Waters. The data used are in-situ data measured at April 22nd 2015 and also estimated brightness temperature data from Landsat 8 Thermal Band Image (band 10 and band 11). The algorithm was established using 45 data by knowing the relation of measured in-situ data and estimated brightness temperature. Then, the algorithm was validated by using another 40 points The results showed that the good performance of the sea surface temperature algorithm with coefficient of determination (R2) and Root Mean Square Error (RMSE) of 0.912 and 0.028, respectively.

Keywords: Sea Surface Temperature, Algorithm, Landsat 8 TIRS, Poteran Island Waters

SMARTKADASTER: OBSERVING BEYOND TRADITIONAL CADASTRE CAPABILITIES FOR MALAYSIA

Mohd Noor Bin Isa, Teng Chee Hua, Nur Zurairah Binti Abdul Halim

Cadastral Division, Department of Survey and Mapping Malaysia, Kuala Lumpur, Malaysia

Abstract The digital age for cadastral surveying started in stages, more than 20 years ago in Malaysia and JUPEM played a vital role in its successful implementation nationwide. One of the key products of cadastral survey is cadastral maps, which provide useful information for any land information system. However, as technology evolved and simplicity is familiarised, better services are anticipated and have affected how cadastral survey information are perceived. A paradigm shift is necessary where enriched cadastral information is required for multiple usage and allow real cadastral information based services to users. On that note, JUPEM is intrigued to develop a system where National Digital Cadastral Database is value added with other geospatial information for a smart and multipurpose environment and clearly be interpreted as a decision making tool with the aids of 3D realistic spatial data, namely SmartKADASTER. The SmartKADASTER is an ongoing project developed by JUPEM with the aim to establish a realistic and SMART cadastral-based spatial analysis platform for an effective planning, decision making, enabling efficiencies and enhancing communication and management to support SMART services towards SMART City enablement in Malaysia. It is developed in phases with the Federal Territory of Putrajaya and Kuala Lumpur as the initial project implementation area. This paper provides awareness and insights of the on-going development of the project and how it could benefit potential users and stakeholders.

Keywords: SmartKADASTER, JUPEM, Multipurpose Cadastre

TERRESTRIAL LASER SCANNERS SELF-CALIBRATION STUDY: DATUM CONSTRAINTS ANALYSES FOR NETWORK CONFIGURATIONS

Mohd Azwan Abbas[1], Halim Setan, Zulkepli Majid[2], Albert Chong[3], Lau Chong Luh[2], Khairulnizam M Idris[2] and Mohd Farid Mohd Ariff[2]

[1]Universiti Teknologi MARA,

[2]Universiti Teknologi Malaysia,

[3]University of Southern Queensland

mohdazwanabbas@yahoo.com, halim@utm.my, zulkeplimajid@utm.my, chonga@usq.edu.au, lauchongluh@gmail.com, khairulnizami@utm.my, mfaridma@utm.my

Abstract Similar to other electronic instruments, terrestrial laser scanner (TLS) can also inherent with various systematic errors coming from different sources. Self-calibration technique is a method available to investigate these errors for TLS which were adopted from photogrammetry technique. Nevertheless, the network configuration applied in both TLS and photogrammetry techniques are quite different. Thus, further investigation is required to study the effect of datum constraints to TLS self-calibration. To ensure that the assessment is thorough, the datum constraints analyses were carried out using three variant network configurations: 1) minimum number of scan stations; 2) minimum number of surfaces for targets distribution; and 3) minimum number of point targets. Based on graphical and statistical, the analyses of datum constraints selection indicated that the parameter correlations obtained are significantly similar. In addition, the analysis has demonstrated that network configuration is a very crucial factor to reduce the correlation between the calculated parameters.

Keywords: Terrestrial laser scanner, Self-calibration, Network configuration, Datum constraints

UTILIZING MOBILE SENSING TO INVESTIGATE THE EFFECTS OF URBAN SPACE ON USERS BEHAVIOR

I. H. Hijazi [1], R. El Meouche[2], A. Khan [3], N. Aboud [1]

[1]An-Najah National University, Urban Planning Engineering, Nestablus, Palestine
eehab@najah.edu

[2]Université Paris-Est, Institut de Recherche en Constructibilité, Cachan, France
relmeouche@adm.estp.fr

[3]Karakoram International University, Pakistan
aftabhunzai@gmail.com

Abstract Space syntax theory was used by many researcher to determine the correlation between people behaviour and urban configuration. However, the data collected for these studies using traditional data collection methods such as questionnaire and interviews, this is associated with inaccurate and biased in data. Wireless devices and smart phones and their sensing capabilities now can be involved in solving several issue. Many mobile applications have been developed with which people are able to keep track of their daily life details. In this research mobile sensing is used to track the location and activities of users in university campuses, the collected data is correlated to space properties to interfere the open space effects on student activities in a university campus. The paper utilize Mobile GPS and accelerometer sensors to sense people behaviour in urban configuration.

Keywords: Space syntax, Mobile sensing, GPS, Human behaviour

FIG

ASSESSMENT OF COURSE OUTCOMES FOR CIVIL ENGINEERING STUDENTS – GEOMATICS ENGINEERING COURSES IN UKM

Khairul Nizam Abdul Maulud

Abstract Learning and education of Geomatics Engineering courses conducted at the Department of Civil & Structural Engineering, UKM is comprehensive, covering theoretical and practical aspects. The evaluation will be based on the program outcomes (PO) and course outcomes (CO) that have been determined. PO assessed was PO1 (Engineering Knowledge), PO2 (Problem Analysis), PO4 (Investigation), PO5 (Modern Tool Usage) and PO10 (Individual and Team Work). The goal of this course is to give knowledge, understanding and synthesis in Geomatics Engineering. The students will be exposed to practical and theoretical knowledge regarding of level measurements, angles and distances. The students are also exposed to the determining the area of landfill and reclamation, setting-out, traversing, tacheometry, vertical and horizontal curves, area and volume of earthwork and land acquisition. Students are also exposed to the latest geospatial sciences such as photogrammetry, remote sensing, GIS, GPS and hydrographic survey. At the end of semester, students are required to undertake two weeks surveying camp to carry out a comprehensive fieldwork surveying. This course is a core subject in the Department of Civil & Structural Engineering, Universiti Kebangsaan Malaysia.

Key words: Education; Course Outcomes; Universiti Kebangsaan Malaysia; Geomatic Education

CONTINUOUS QUALITY IMPROVEMENT ON GEOMATIC COURSE IN USM ENGINEERING PROGRAM USING COURSE OUTCOMES ATTAINMENT

Mohd Sanusi S. Ahamad, and Dato' Wan Muhd Aminuddin Wan Hussin

Universiti Sains Malaysia

cesanusi@gmail.com, cewan@usm.my

Abstract This paper presents a framework for ensuring continuous quality improvement (CQI) of course outcomes (COs) as required in the Outcome Based Education recently introduced to all engineering programs in Malaysia. The major responsibility of an academic staff is to ensure that their course meets the listed course outcomes, which are directly linked to the program outcomes (POs). The CQI exercises at the course level will involve analyses of coursework marks and final examination marks. The results are obtained from the direct measurement, via assignments, tests, and examinations; and the indirect measurement, via student assessment survey at the end of the semester. The direct PO assessment is calculated for every student based on the attainment of the COs of every course. Course outcomes are achieved if the attainment of that outcome is more than or equal to 40%. This stated framework has been carried out by the school and has been endorsed by the Engineering Accreditation Council (EAC) from the Board of Engineers (BEM) Malaysia.

Keywords: Continuous quality improvement, Program outcomes, Course outcomes

EDUCATION OF GEOINFORMATICS (GIS) AT UNIVERSITI TEKNOLOGI MALAYSIA (UTM)

Mohammad Zakri Tarmidi, Uznir Ujang, Nurul Hawani Idris, Azman AriffinN, Kamaludin Mohd Omar, and Zulkepli Majid

Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia

Abstract The field of Geographic Information Sciences (GIS) has emerged for several decades to support in collecting, managing geospatial data as well as planning and making informed decisions for various sectors. The Universiti Teknologi Malaysia used to be the pioneer institution in Malaysia that introduced the Geoinformatics program for undergraduate studies. This paper discusses the implementation of Geoinformatics (GIS) education for undergraduate program in the Universiti Teknologi Malaysia and highlights the reflections from the students, alumni and industry of the program. Analyses from the questionnaires distributed to the current students, alumni and industry stakeholders demonstrated that improvement is needed to strengthen the GIS fundamental knowledge, with example to various fields of applications. This indicates that the program is relevant to serve the stakeholders. Input from various stakeholders is considered periodically in the program implementation to monitor and improve the quality of curriculum offered. This is important so that the producing Geoinformatics graduates always relevant to the industry and other stakeholders and ready to serve the national and international levels.

Key words: Geoinformatics Education, GIS Education, Geoinformation Education, UTM

GEOMATICS – ITS RELEVANCE TO OIL & GAS INDUSTRIES

Abd Nasir Matori, and Amir Sharifuddin Ab Latip

Key words: Geomatics, Geoinformatic, Oil and Gas life-cycle, Geo-referenced.

This paper presents the relevance of Geomatics to the oils and gas industries. It begins with brief definition of various geomatics fields and explanation of oils and gas life-cycle. The role and significance of geomatics and geoinformatics in every step of oil and gas life cycle is explained where applicable. Training of geomatician to ensure supply to the oil and gas and other industries is also mentioned. Geomatics may only play small role in oil and gas industry, however its contribution is critical since almost 80% of oil and gas life cycle data has a geo-referenced component in them. The effect of not so correct geomatic may ripple to the other exploration data which may lead to unfavorable exploration outcome.

GEOMATICS-RELATED EDUCATION AND RESEARCH PROGRAMMES AT THE DEPARTMENT OF CIVIL ENGINEERING, UNIVERSITI PUTRA MALAYSIA (UPM)

Helmi Zulhaidi Mohd Shafri

Abstract Geomatics-related programmes in UPM are not offered at the undergraduate level but they are available at the postgraduate level. This paper focuses on the overview and implementation of geomatics-related programmes at the Department of Civil Engineering, UPM which include the Master of Remote Sensing and GIS programme (coursework), Master by research as well as PhD programmes (by research and industrial PhD).

Keywords: Geomatics, postgraduate studies, education

HUMAN RESOURCE INVENTORY OF GEOMATIC GRADUATES: A CASE STUDY OF UNIVERSITI TEKNOLOGI MALAYSIA

Mohd Faisal Abdul Khanan, Mohd Hafiz Yahya, Tan Liat Choon, Ami Hassan Md Din, Kamaludin Mohd Omar

Abstract Geomatic represents a branch of engineering that comprises the area of Global Navigation Satellite System (GNSS) technology, field surveying, cartography, geodesy, photogrammetry, hydrography and cadastral studies. The current Geomatic degree administered by the Faculty of Geoinformation and Real Estate (FGRE) at Universiti Teknologi Malaysia (UTM) is the Bachelor of Engineering (Geomatic). Introduced in the early 1970s, this bachelor program strives to deliver a quality educational experience via emerging geomatic technologies towards providing significant contribution to the needs of surveying and engineering profession nationwide. This paper encompasses the issue of human resource inventory in relation to the whereabouts and the demographic distribution of geomatic graduates in UTM. For understanding and conducting comprehensive geospatial analysis related to UTM geomatic graduates, Jawatankuasa Alumni Dan Sumber Manusia (JASMG) was formed at FGRE in the year 2014. Preliminary results on the number of graduates, graduates employability, distribution by gender, age and states obtained from the study were presented and discussed in this paper. Despite certain drawbacks in retracing graduates existing careers, it is suggested that a spatio-temporal human resource inventory database is used where their continuous demographic and career information is stored. Incorporating the spatial aspect enables the current employment location of graduates to be mapped while slotting in the temporal aspect are beneficial for continuous observation of graduates' career movement in the future.

Keywords: inventory, geomatic, graduates, survey

IMPLEMENTATION OF UTILITY MAPPING SYLLABUS AT POLYTECHNIC SYSTEM

Mohd Asri Bin Hj. Zahid, Asuralyzah Binti Saleh, Rahizudin Bin Abdul Rahim

Abstract The new state-of-the-art technology and up-to-date knowledge are competencies and skills needed for the semi professional land surveyor to generate future development scenario in land development project, marine development, agro-technology, geospatial industry, geological and geophysical activities. The emphasis of Polytechnic Diploma programme through theoretically subjects and practical method such as lectures, tutorials, assignments, field works, laboratory works, survey camp and industrial training at land surveying firms, engineering consultant firms, local authorities and various government departments are provided to penetrate employment market with supporting skills such as technical skills and soft skills. This will give the students some added value which are relevant to the requirement of Licensed Land Surveyors Board (LJT), Royal Institution of Surveyors Malaysia (RISM) and Department of Survey and Mapping, Malaysia (JUPEM). The accreditation from the Royal Institution of Surveyor Malaysia (RISM), Licensed Land Surveyors Board (LJT), related universities, government departments and Licensed Land Surveyors Consultant firm is the important requirement in order to complete the curriculum development process. And finally expection of the outcomes of these utility mapping syllabus is to exposes the students to the definition, history, objectives, scope, method of survey, processing and mapping of underground utility mapping. To provides give knowledge to the students in field works such as determining the positions of underground materials on earth surface.

Keywords: Outcome-Based Education, Syllabus, Underground, Utility Mapping

CALL BEFORE YOU DIG

Mohd Zaidi Mohd Basir

General Manager Data Network Management, Telekom Malaysia

Abstract Call Before You Dig (CBYD) is a program established to protect TM underground infrastructure with regard to excavations near to the facilities by providing an assistant to infrastructure developer, public agencies and public utilities. The establishment is to protect nation and public interest by minimising telecommunication infra damage through safe digging and drilling practice. Telecommunication underground facilities damage can cause severe impact to public and nation especially to essential services such as emergency response services, safety and defence services, financial services as well as government services.CBYD assists third party excavators to identify TM's underground infrastructure location and position before execute any digging and drilling work, so excavators can conduct their work without causing any damage.

LEAP FORWARD IN GPR TECHNOLOGY – HIGH DYNAMIC RANGE

Md Yunus Wahab

Abstract The presentation will concentrate on latest technology update on High Dynamic Range (HDR) Ground Penetrating Radar system which is now available in the market. It is a new innovation from MALA Geoscience which is based on model Real-Time Sampling technology. Most of the conventional GPR technique uses "Equivalent Time Sampling", the HDR in comparison gives greater signal to noise ratio thus great depth penetration, high resolution and faster acquisition. A simple explanation on the HDR technology will be covered during the presentation with outlines the benefits of the technology for the underground utility mapping applications.

UNDERGROUND UTILITY DETECTION AND MAPPING (UUDM) – PROFESSIONAL APPROACH, CHALLENGES & SOLUTION

Logisvarran MUNIANDY and Kahar ABDULLAH

Association of Authorised Land Surveyors Malaysia (PEJUTA)

Abstract Underground utility survey uses a combination of non-intrusive techniques to provide a comprehensive record of the sub-surface services without the need for digging. It is required to assist in the planning and management in a development. The lack of such inaccurate information during design and construction activities may result in costly conflicts, delays, utility service disruptions, redesigns that would lead to tangible financial loss not to mention personal injuries and precious lost lives. Limitation of technology, lacking of professional competency and inadequate of legislation controls are some of the challenges the industry faces to provide these vital accurate information. While some would take years to compensate for such lacking, a holistic professional approach with end to end procedure in carrying out underground utility survey would have to be adopted to maximize the confidence level of final findings ensuring a professional result in mapping underground utilities and anomalies. Due to the increasing number of so-called utility survey specialist producing sub-standard results, Association of Authorized Land Surveyors Malaysia (PEJUTA) with the cooperation from Land Surveyors Board Malaysia (LJT) and Department of Survey and Mapping Malaysia (JUPEM) has been involved in providing an accreditation course since 2011 to provide knowledge and competency to the practicing land surveyors although it must be noted that expertise can only be attained through experience. The process to equip the practicing surveyors with the knowledge and expertise for the consistency, reliability and accuracy of utility survey reports by properly trained and accredited personnel should be on-going dynamic investment underlying for an orderly management of underground services among the stakeholders in the industry. This paper enumerates on the importance to adopt a professional holistic approach in carrying out a utility survey to tackle some of the technical challenges in producing accurate representation of underground services.

Keywords: underground utility mapping, land surveyors

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