Graduate Seminar

&

Student Technical Conference

Wednesday March 25th, 2015

Department of Geodesy and Geomatics Engineering

University of New Brunswick

The Department would like to welcome you to the

Spring 2015 Graduate Seminar & Student Technical Conference

Where:

Gillin Hall – Room D-108

When:

Wednesday, March 25th 2015 at 10:00am

Department of Geodesy and Geomatics Engineering

Geodesy and Geomatics Engineering

Graduate Seminar and Student Technical Conference

Spring 2015

Chair: *Ryan White (MScE)*

Wednesday, March 25th 2015 *(GD108)*

9:55 **Welcome note**

10:00 **Spatial and Spatio-Temporal Analysis Tools for New Brunswick Ground Search and Rescue Teams**

Scott Fraser (MEng)

10:15 **Platoon Reconnaissance Using Head Worn Displays**

Shahab Rezaei-Zadeh (MEng)

10:30 **Contextual Douglas-Peucker Simplification**

Titus Tienaah (PhD)

10:45 **A Geospatial web application for applying more actively the adjunct mode in practical courses of Surveying Engineering**

Jaime Garbanzo Leon (MScE)

11:00 **Assessing Land Cover Dynamics in the Grand Lake Meadows with the use of Satellite Imageries**

Oluwatimelehin Shodimu (MScE)

11:15 **Estimation and Mapping of Spruce Budworm Defoliation Using Vegetation Indices Derived From Hyperion Hyperspectral Data**

Zhongwei Huang (MScE)

11:30 **Exploiting Spectral and Spatial Information for Mapping Spruce Budworm Defoliation Using Hyperion Hyperspectral Data**

Zhongwei Huang (MScE)

11:45 **A Novel Approach for Mapping the Aboveground Disparity to Support Stereo-based Building Detection in Off-nadir VHR Satellite Imagery**

Alaeldin Suliman (PhD)

12:00 **Understanding Tile Map System for Web Map Applications**

Amir Abouhamzeh (MScE)

12:15 **Rasterizing GIS Data for 3D Visualization**

Amir Abouhamzeh (MScE)

12:30 **Computation of a Geoid Model for Ghana Using the Stokes-Helmert Method**

Michael Klu (MScE)

12:45 **Improving Shallow Water Multibeam Target Detection at Low Grazing Angles**

Douglas Luiz Pereira (MScE)

1:00 **Application of Repetitive Multibeam Survey and Hydrodynamic Model to Understand Delta Evolution, Squamish River, BC**

Danar Pratomo (PhD)

1:15 **Separating Across-Track Radiometric Beam Pattern from Angular Variation of Multibeam Backscatter Data**

Anand Hiroji (PhD)

1:30 **Closing Remarks**

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ABSTRACTS

Contact the Authors for a copy of the full papers.

Department of Geodesy and Geomatics Engineering

Spatial and Spatio-Temporal Analysis Tools for New Brunswick Ground Search and Rescue Teams

Scott Fraser

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Abstract

Two programs were created to both quantify and thereby better inform some of the routine geospatial and spatio-temporal analyses commonly performed by search team leaders in New Brunswick. The first program assigns probabilities of detection (POD), a percentage probability that a lost person will be found in an area if they were in that area, to a given set of search area partitions using a land cover raster and an aspect raster. In order to account for the view obstructing effect of undulating terrain, a focal statistics operation is used to quantify the amount of aspect variety surrounding each cell. The resulting aspect variety raster is then reclassified according to the level of view obstruction presented by different levels of undulation and multiplied by the POD raster before a zonal statistics operation is executed to assign PODs to the partitions. The second program uses ArcGIS's path distance tool, a user provided point representing the last place a subject was seen, an estimate of the subjects average pace, a digital elevation model and a land cover raster to produce a raster whose cell values correspond to the number of hours it would take an individual to reach a cell. As the values used to represent the view obstructing and impedance to movement imposed by different types of land cover in these programs were estimates, experiments were designed to obtain more accurate values.

Platoon Reconnaissance Using Head Worn Displays

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Abstract

The Canadian Forces uses small military detachments in order to conduct reconnaissance behind enemy lines. These detachments gather battlefield intelligence and transmit the data via radio, written reports and site sketches to the head quarter in order to enable the Operational Planning Process (OPP). The current standard operating procedures (SOPs) have some inherent flaws. The members of the reconnaissance (recce) detachments spend days behind enemy lines for days in close proximity to the enemy and exposed to the elements therefore the site sketches that are produced are not to scale and of poor quality. Since the recce detachments are isolated, the sketch might not make it back to the battalion headquarters for days.

The long-term goal of this project is to use Head Worn Displays, similar to Google Glass, in order to assist the recce detachment and limit the number of equipments that they have to carry. Google Glass has a built in GPS receiver, gyroscope and camera that will assist in the recce. It does not have a built in hardware in order to determine the coordinates of a certain point of interest. The short-term goal this project is to use the fundamentals of photogrammetry and specifically the collinearity equations along with the device's sensors to create an Android application that is capable of determining the coordinates of a point of interest.

Since Google Glass hardware was not available, a Samsung Galaxy S4 cellphone was utilised as a proxy. Development efforts, challenges encountered and results to date are discussed, along with recommendations for future development.

Contextual Douglas-Peucker Simplification

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Abstract

In this paper, we develop a constrained Douglas-Peucker algorithm using a polyline to be simplified and other geometries as contextual constraints. We develop a contextual model that incrementally rewinds to the original polyline with relevant characteristic vertices to resolve contextual conflicts. Constraints covered in this paper are topology and direction. Our implementation shows a consistent representation and a technique to accelerate multi-scale simplification of polylines.

A Geospatial web application for applying more actively the adjunct mode in practical courses of Surveying Engineering

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Abstract

The adjunct mode, E-learning combined with face-to-face teaching, is commonly used in education today. However, there are field practical courses in which this approach can be more actively applied. Survey Engineering has many courses, in which the field practical component is a large part of the course curriculum. The problem is how to apply the E-learning approach to a field practical course more actively. A solution can be provided by a GEOWAPP (Geospatial Web Application), which takes advantage of internet services. Such a tool was developed for four exercises: a traverse, two levelling exercises, and a topographic survey exercise. Five tools were developed to support these exercises. These tools were designed for two types of users, students and instructors. In this paper, several aspects of these tools will be addressed, including their theoretical framework and their outputs. Google maps API improves the visual component of the GEOWAPP. This GEOWAPP was deployed in a server and tested with text book exercises and synthetic data. The results show that the GEOWAPP functionality is operational. A user review remains to be done in order to gather more useful feedback for this research.

Assessing Land Cover Dynamics in the Grand Lake Meadows with the use of Satellite Imageries

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Abstract

Grand Lake Meadows (GLM) are viewed as a truly and naturally significant area in the province of New Brunswick. On the other hand, there have been changes in the land cover and utilization of the area, primarily due to the re-routing of the Trans-Canada expressway and the development of settlements such as Gagetown in the area. Changes in the land use and land cover (LULC) extensively influence key parts of biological system working and administrations.

The main objective of this study is to assess and evaluate the land use land cover changes, specifically the vegetation cover, of the GLM area using archival satellite imageries dating back as far as the 1990's. In parallel, the study determines the most suitable spatial scale and the best method to extract meaningful information from these imageries.

Geographic Information System (GIS) is utilized to portray the spatial and temporal changes of the GLM. The area and extent of afforestation or deforestation is determined over time to evaluate the condition of vegetative cover of the GLM area for environmental monitoring. The study identified a 6% increase in the forest vegetated land from the 1990 to 2001, while there was 30% decrease in the vegetated area since then. The result will help the managers to comprehend the dynamics of the changes, prompting a better management and implementation of LULC administration in the GLM area.

Estimation and Mapping of Spruce Budworm Defoliation Using Vegetation Indices Derived From Hyperion Hyperspectral Data

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Abstract

Defoliation during spruce budworm outbreaks causes severe, widespread damage to spruce and balsam fir forests in eastern Canada. Early estimation of the defoliation will provide crucial support to mitigate the socio-economic impact on vulnerable forests. The affected region usually consists of large and inaccessible forestry areas which make any direct survey methods to be inappropriate and time consuming. In this study, we give estimation and mapping of defoliation for a study site in the province of Quebec, Canada using vegetation indices constructed by remotely sensed Hyperion hyperspectral data. 11 existing and developed vegetation indices (VIs) are constructed using 162 available Hyperion bands. The correlation between those VIs and the aerial survey defoliation results conducted by Quebec government covering same region are calculated. Decision on choice of bands for defoliation mapping has been made based on the correlation results. The mapping results using both conventional and developed VIs are compared in the experiments. The experimental results suggest non-linear VIs developed in this paper suggest better performance over conventional linear VIs in both estimation and mapping tasks.

Exploiting Spectral and Spatial Information for Mapping Spruce Budworm Defoliation Using Hyperion Hyperspectral Data

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Abstract

As an indirect surveying method, remote sensing technique has special advantages on monitoring and mapping the forestry properties that caused by external damages. The spruce budworm (SBW) defoliates dramatically the spruce and balsam fir forests in eastern Canada. Timely and accurate mapping of the defoliation will provide crucial support to mitigate the socio-economic impact on vulnerable forests. In this study, we provide a method for mapping SBW defoliation for a study site in the province of Quebec, Canada using remotely sensed Hyperion hyperspectral data. The Hyperion data provide fine spectral resolution among a wide range of spectral wavelengths which allows for spectral information extraction. However, its spatial resolution is relatively coarse (30m) which results in dominant mixed pixels especially in homogenous forestry regions. Such condition makes conventional mapping methods that need pre-located and labeled endmembers very difficult to use or even inapplicable. In this study, we propose a mapping method that exploits both spectral and spatial information from hyperspectral data. The method requires no pre-labeled endmembers and uses an unsupervised K-means classifier to map the defoliation. As relevant features are exploited, the classifier performs better than applied on original high dimensional data or other dimensionality reduction method such as Minimum Noise Fraction (MNF) Transform.

A Novel Approach for Mapping the Aboveground Disparity to Support Stereo-based Building Detection in Off-nadir VHR Satellite Imagery

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Abstract

Building detection is an important application for planning and managing urban areas. Very high resolution (VHR) satellite images provide substantial information content necessary for mapping complex environments. However, it is difficult, in the detection approaches using mono VHR images, to delineate different classes of impervious surfaces when they have similar appearance. On the other hand, stereo-based approaches provide more reliable delineation since they incorporate the key component for detecting buildings (i.e., the third dimension). However, off-nadir VHR stereo images have inherent occlusions close to building edges which produce no-data regions in the measured disparity maps. Interpolating these regions, in urban areas, results in misleading information in the extracted terrain disparity and the normalized surface disparity. Therefore, this paper proposes an approach for mapping directly the disparity data that represents only the aboveground objects (i.e., normalized disparity data) to mitigate the occlusion effects by co-registering the terrain-level objects in an epipolar pair of off-nadir VHR stereo images. A building detection application relying solely on the disparity information measured is implemented. By the almost zero-disparity threshold value, the overall quality of the detection achieved is found to be 75% with a detection correctness of almost 100%. The detection is executed by only one-pair of off-nadir VHR stereo images which affects the application cost positively. Moreover, the detected objects are only building rooftops which resulted from the use of two opposite off-nadir VHR images (i.e., backward and forward) of wide stereo angle in the novel approach proposed.

Understanding Tile Map System for Web Map Applications

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Abstract

Web mapping has become a popular means of distributing interactive digital maps over the internet. Traditional web map services generated map images on the fly each time a request was received, that restricted service scalability and offered a poor user experience. Preferred web map services, like Google Maps or Microsoft Virtual Earth, have demonstrated that an optimal delivery of online mapping may be achieved by serving pre-generated map image tiles from server. Producing and updating geospatial information is expensive and resource intensive. To develop an application for the web primarily based is one in every of the most recent challenges developers face these days. This paper reviews the famous Tile Map system, its data structure, projection and mathematical background, related geospatial indexing and its crucial importance in delivering GIS data to web mapping applications.

Rasterizing GIS Data for 3D Visualization

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Abstract

In the past few years, storage and organization of global massive multi-dimensional remote sensing data had a big impact on the performance of Web mapping systems as well as standalone applications. With the increasing popularity of global on-line mapping web applications (e.g. Google Maps, Microsoft Virtual Earth, Yahoo Maps), Tile technique is widely used. To implement a 3 dimensional Web mapping system, we propose a modified version of global grid division pyramid hierarchical method for vector data rasterization. This paper proposes a solution for creating raster layer on top of satellite image providing hybrid map information on top of a 3D visualized satellite image mosaic (using Digital Elevation Model for 3D visualization). In this approach, different options for automatically rasterizing vector data for each zoom level based on level of details model are investigated and 3D visualization considerations are taken into account.

Determination of Ghanaian Gravimetric Geoid from Sparse and Varying Data Density using the Stokes-Helmert Method

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Abstract

The aim of this research is to compute a gravimetric geoid model for Ghana using the Stoke-Helmert approach which was developed at the University of New Brunswick (UNB). A gravimetric geoid model of Ghana is important because of the use of Global Positioning System (GPS) for all survey and mapping activities in the country. This geoid model is to enable surveyors and mapping professionals in converting geodetic heights to orthometric heights which is more useful. In spite of the sparse terrestrial gravity data of variable density, distribution and quality, this research aims to model the geoid as accurately as achievable. To model a regional gravimetric geoid using the modified Stokes formula requires a combination of terrestrial gravity data of the area and a Global Geopotential Model (GGM).

In this research, a two-space setup will be used in formulating the boundary value problem and defining gravity values (quantities), which will be appropriate for downward continuation from the Earth's surface to the geoid level. The topographical effect will be formulated in spherical form. The solution of the Stokes boundary value problem employs a modified Stokes formula in conjunction with the low-degree contribution of a GGM.

The data set used for the computation will consist of gravity data, various rock densities covering the entire country of Ghana and the European Improve Gravity field of the Earth by New techniques and Gravity Recovery and Climate Experiment (EIGEN-GRACE) mission for the global geopotential model. Regarding the evaluation and refinement of the terrestrial gravity data, the cross-evaluation technique will be used for the detection of outliers.

The geoid model for Ghana will be tested with GPS Levelling data from areas with varying terrain such as a low terrain and a relatively high terrain and any discrepancy will be investigated.

Improving Shallow Water Multibeam Target Detection at Low Grazing Angles

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Abstract

Beyond ~ 60º incidence angle, many modern multibeam echo sounders have difficulty maintaining sufficient depth accuracy and seabed target detection to comply with International Hydrographic Organization (IHO) standards. In some cases, a target at such a low grazing angle is not detected due to limitations of the existing bottom detection method and filters applied by the manufacturer. In lieu of clear positive bathymetric indicators, a data gap within the bathymetric surface or a shadow in the backscatter image may be the only indication of the presence of that target.

This paper presents a refined bottom detection algorithm based on the Bearing Direction Indicator (BDI) method. The algorithm can be applied in post processing as long as the water column data is retained. This approach can markedly improve target detection capability at low grazing angles in shallow waters by independently discriminating each echo's direction of arrival irrespective of the beam spacing. Two test datasets were collected using an EM 2040D employing angular sectors as wide as +/-82°. Data were acquired over a site with multiple IHO compliant anthropogenic objects to assess the ability to detect low grazing angle targets prior to, and after, application of the newly-developed algorithm. Results obtained clearly illustrate that the BDI algorithm can enhance low grazing angle target detection capability.

Application of Repetitive Multibeam Survey and Hydrodynamic Model to Understand Delta Evolution, Squamish River, BC

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Abstract

The mechanism of growth and collapse of a delta lip is affected by the manner in which the available sediment flux from the feeder fluvial system is distributed. Repeat multibeam surveys and hydrodynamic modelling are used to understand this mechanism on the Squamish delta. The multibeam data capture the instantaneous expression of both the long wavelength channel shape as well as the superimposed bedforms distribution (as preserved at high water). While the long wavelength shape changes over a time scale of about a week, it is clear that the individual bedforms cannot be correlated from one tide to the next, indicating much faster evolution.

Preliminary observations of the delta lip clearly demonstrate that the current speeds on the delta top are strongly modulated by the tide, ranging from almost stationary at high water to in excess of 5 knots at low water. To quantify the bed shear stress associated with this modulation, a 3D hydrodynamic model was built to predict the flow within the river, the delta top, and adjacent fjord over the complete tidal cycle. This clearly shows that the sediment flux is dominated by the low water period when the off-delta flows are strongest. The peak intensity of those flows is in turn modulated by the spring-neap cycle and variation in river discharge. This matches complementary work using repetitive multibeam off the delta lip that shows that mass wasting on the delta front is highly correlated with a combination of river surges, the spring tide and low tide periods.

Separating Across-Track Radiometric Beam Pattern from Angular Variation of Multibeam Backscatter Data

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Abstract

The use of acoustic multibeam backscatter data for bottom characterization is currently being attempted by many researchers to aid geological, biological and engineering projects. Ideally an estimate of bottom backscatter strength would be measured but in reality the observed data has only approximately been reduced to that value. The existing post processing algorithms undertake imperfect corrections to account for geometric and radiometric effects. Recent developments in motion stabilization, which are used to achieve higher and more equal sounding density, have added additional radiometric complications to the backscatter data. Before the backscatter data can be used for classification, either in the form of mosaic or in the form of backscatter strength angular response curves, the residual artifacts in the data have to be properly minimized.

This paper describes an improved method of reducing the backscatter data by explicitly differentiating between across-track radiometric artifacts and the seafloor angular response. Over a homogeneous reference area, the backscatter strength at a specific grazing angle remains constant and should not depend on the angle of transmission at the sonar. As a result, any variation with changes in sonar-relative angle can therefore be unambiguously attributed to radiated intensity and receiver sensitivity variation. The data collected while the vessel was under heavy roll is used in this method to ensure that a specific grazing angle has a large range of respective sonar-relative angles. The variation in the intensities around each sonar-relative angle is extracted and then compiled on a sector by sector basis. To estimate the shifts between source levels of different sectors, the obtained mean intensity variations for each sector are related to a common reference for the entire swath using those subsets of backscatter data that have common grazing angles.

To obtain better estimates of the backscatter strength angular response curve, the improved algorithm is used to extract sonar-relative across-track radiometric beam pattern which is then removed from the raw backscatter data. At this point, an unambiguous estimate of the local seabed backscatter strength angular response curve can now be derived. In order to obtain the angle normalized backscatter image or mosaic from the raw backscatter data, a two stage process is applied. This involves utilizing both the extracted across-track radiometric beam pattern relative to sonar as well as the obtained angular response curves relative to grazing angle.

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