Graduate Seminar

&

Student Technical Conference

Thursday March 16th, 2017

Department of Geodesy and Geomatics Engineering

University of New Brunswick

The Department would like to welcome you to the

Spring 2017 Graduate Seminar & Student Technical Conference

Where:

Head Hall – Room H-301

When:

Thursday, March 16th 2017 at 12:30pm

Department of Geodesy and Geomatics Engineering

Geodesy and Geomatics Engineering

Graduate Seminar and Student Technical Conference

Spring 2017

Chair: *Alexander Paul Russell Turner (MScE; year 1)*

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Thursday, March 16th 2017   *(H-301)*
</div>

12:25   **Welcome note**

12:30   **Computing the Phase of Mobile Oscillators using a Mobility Metric and the Hilbert Transform**

   Ma Dolores Arteaga Revert (PhD; year 4)

12:45   **Locating Maple Stands on NB Private Property and Crown Land Parcels to Promote Maple Sap Harvest**

   Eric Godin (MEng; year 2)

1:00   **LevelFilesSet: An Efficient Data Structure for Storing and Retrieving Tile Images**

   Menelaos Kotsollaris (MScE; year 2)

1:15   **Semantically Enriched Line Simplification for Static Linear Features**

   Rajesh Tamilmani (MScE; year 1)

1:30   **A Web Geospatial Infrastructure for Visualization of Coastal Erosion**

   Yessica Enriquez (MSc; visiting student)

1:45   **Break**

2:00   **Assessing PPP Derived Zenith Total Delays Using the NIGNET**

Omeiza A. Mayaki (MScE; year 2)

2:15   **Optimal combination of satellite and terrestrial gravity data for regional geoid determination using Stokes-Helmert's method**

Ismael Foroughi (PhD; year 4)

2:30   **Rigorous Evaluation of a Satellite-Only Gravitational Model**

Michael Sheng (PhD; year 3)

2:45   **Assessment of Performance of Current State-of-Art Tropospheric Mapping Functions: UNB-VMF1 vs VMF1**

Thalia Nikolaidou (PhD; year 3)

3:00   **Proposing a Measurement-Based Geospatial Data Management System**

Mike Bremner (MScE; year 2)

3:15   **No-Reference Perceptual Quality Measurement for Color Images**

Aditya Roshan (PhD; year 5)

3:30   **Closing Remarks**

Spring 2017 Graduate Seminar & Student Technical Conference

ABSTRACTS

Contact the Authors for a copy of full papers.

Department of Geodesy and Geomatics Engineering

Computing the Phase of Mobile Oscillators using a Mobility Metric and the Hilbert Transform

Ma Dolores Arteaga Revert

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Abstract

Computing the phases of mobile oscillators is crucial for determining their synchroniza-tion. Traditionally, synchronization models do not consider the spatial structure of the oscillators, and it is still missing how to compute the phases of oscillators that are moving in the two-dimensional (2D) space. In this paper, the oscillators' phases are computed using a mobility metric, the acceleration, and the Hilbert transform. This way, the movement in the 2D space of the oscillators is considered. The experiment has been conducted considering vehicles moving freely on a highway as mobile oscillators. Preliminary results show that the phase dynamics of the oscillators are coupled to spatial clusters, meaning that certain spatial regions have similar phase values. Those results indicate that the synchronization can take place not only thru time, but also in space. This novel spatial synchronization opens a new way for studying the vehicle's dynamics on a highway.

Locating Maple Stands on NB Private Property and Crown Land Parcels
to Promote Maple Sap Harvest

Eric Godin

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Abstract

New Brunswick is the second largest producer of maple syrup products in Canada. The 2013 Statistical Overview of the Canadian Maple Industry reported that it represented 3.40% of maple product exports. Maple syrup products are becoming more and more popular over the years especially overseas where it has become a novelty.

Being able to locate suitable maple stand locations by web interaction tools to harvest maple sap can be very useful for individuals wanting to partake in this type of agriculture. GIS will save search time for a person looking to invest in such business. While giving knowledge to current land owners of the potential of their assets and add value to them, it can also help the government select and lease land parcels with enough sugar maple trees to harvest sap at ideal locations. Once parcels are identified a physical confirmation can be done by going to the sites for inspection.

Cutting edge technology such as geographic information systems, ArcGIS model builder, was used to develop a model to locate the best sugar bush location and parcels on private property based on several criteria including forest species, slope, aspect and proximity to roads.

In turn, the sub models were used to isolate parcels containing more that 2 hectares of maple stand were identified on private and Crown lands property based on Jul-Aug 2016 data. Using ESRI map journal and ArcGIS Online, two interactive web maps were created to see where these parcels are located within NB for each County. Due to the limitation of features to be publish online, the data represented on the published maps are maple stands with a minimum potential of 2000 taps on Crown Lands and private property parcels, based on 150 maple trees per hectare density with tapping ratio of 1.5 per tree.

LevelFilesSet: An Efficient Data Structure for Storing

and Retrieving Tile Images

Menelaos Kotsollaris

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Abstract

The purpose of this paper is to present an advanced data structure, named LevelFilesSet, which stores and retrieves tile images in an optimal way. The core functionality of a tile management system is to provide tile images to the end user that represent the web map. Three data structures are analyzed: The SimpleFormat, which stores the files directly in the file system; the ImageBlock, which divides each tile folder in subfolders that contain multiple images prior to storing the tiles on the file system; and the LevelFilesSet, a data structure that creates dedicated Random-Access files wherein the tile dataset is first stored and then parsed in files to retrieve the tile images. Three benchmarking tests are developed and assessed under different system configurations to compare the techniques and provide a spherical analysis of their efficiency. The LevelFilesSet was found to be able to retrieve tiles up to 3.3 times faster than the other techniques. Additional features and potential improvements are proposed to enrich the LevelFilesSet and make it a scalable and efficient tile management solution for handling large volumes of datasets across multiple systems.

Semantically Enriched Line Simplification for Static Linear Features

Rajesh Tamilmani

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Abstract

Polyline geometries are used to represent the linear features such as roads, rivers, and pipelines on maps. The process of simplifying the geometry by means of sampling and generalization produces polylines that are shorter in length than original geometries. In addition to that the simplification process may end up in losing the semantics associated with the actual line features. The semantic loss is directly proportional to the scale of the map. This paper involves implementing the SELF (Semantically Enriched Line simpliFication) data structure to overcome the above problem by preserving the length attributes associated to individual points on actual linear features. The number of points to be stored in the SELF structure is optimized by applying alternative compression techniques. The data structure has been implemented in PostgreSQL 9.4 with PostGIS extension using PL/pgSQL to support static and non-functional polylines. Extended experimental work has been carried out to better understand the impact of simplification to both synthetic and real (natural and artificial) linear features. The efficiency of SELF structure as regards to semantic preservation was tested at various levels of simplification.

A Web Geospatial Infrastructure for Visualization of Coastal Erosion

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Abstract

The internet is a valuable tool to communicate and share information on coastal region. Nonetheless as it is understood, we haven't gotten to the point where these tools have not taken full advantage of current "Web 2.0" technologies that promote information sharing and collaboration. In order for data or information to be useful for coastal management, it must be both comprehensive and accessible. The present research for a web geospatial infrastructure for visualization of coastal erosion addresses the issues of simple access to data and information in a timely fashion which are challenges for anyone involved in the management of coastal areas. The research envisions a third party access tool for data visualization and retrieval that will help in decision-making. The proposed infrastructure takes into consideration that the available data is not easily accessed and unless users have an academic degree in the use of spatial data it is difficult to understand and consume. Earth observation (EO) systems are invaluable for the assessment and mitigation of the negative effects the human race is having on the environment, since, for example, EO tools and products can be used to explore and exploit new opportunities in the sustainable management of natural resources. The goal of the research is to design and implement an automated web infrastructure using geographic information systems to analyse remotely sensed coastal imagery and with this, generate temporal crust deformation models that can be displayed and published through the internet and can be accessible to the general public.

Assessing PPP Derived Zenith Total Delays Using the NIGNET

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Abstract

Global Navigational Satellite System (GNSS) observables are valuable information sources for the routine monitoring of the Earth's atmosphere using ground-based GNSS receivers. Compared to other atmospheric monitoring techniques, GNSS offers the advantages of having high temporal and spatial resolutions as well as accuracy. These qualities make GNSS suitable for meteorology, to derive information about the state of the neutral atmosphere (troposphere). Many nations utilize dedicated GNSS receiver networks including Continuously Operating Reference Stations (CORS) for operational weather and climate services. However, in Nigeria, the situation appears to be different. The focus of this research is to assess the adaptability of the Nigerian GNSS Reference Network (NIGNET) and the nearby International GNSS Service (IGS) stations for meteorological applications by determining the Zenith Total Delay (ZTD) at the station. The ZTD can be transformed to Integrated Water Vapor (IWV) content in the troposphere, which is an essential parameter in weather forecasting, climate change and variability analysis. Using Precise Point Positioning (PPP) technique, ZTD estimates are derived from daily data obtained from the NIGNET CORS and IGS stations spanning from 2011 to 2016. These ZTD estimates are compared with ray-traced delays from the global Numerical Weather Model (NWM) of the National Centre for Environmental Prediction (NCEP), and Zenith Path Delay (ZPD) estimates from the IGS final troposphere product. A comprehensive time series analysis is performed to access the level of agreement of the products and identify possible systematic effects arising from the different techniques.

Optimal combination of satellite and terrestrial gravity data for regional geoid determination using Stokes-Helmert's method

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Abstract

Precise regional geoid modelling requires combination of terrestrial gravity data with satellite-only Earth Gravitational Models (EGMs). The relative contribution of terrestrial and satellite data to the computed geoid is specified by the integration cap size (defined by the spherical distance ψ_0) and the degree and order of reference field, and thus of the reference spheroid (l_0). Higher degrees of l_0 decrease the role of terrestrial data and increase the contribution of satellite data and using larger ψ_0 works the other way around. The determination of the optimal combination (l_0, ψ_0) is numerically investigated in this paper. A numerical procedure is proposed to find the best combined solution by comparing the derived gravimetric geoidal heights with GNSS/levelling. The proposed method is tested over the Auvergne geoid computation area. The results show that despite the availability of high-degree satellite-only EGMs (max degree/order 300), l_0=160 and ψ_0= 45' give the best fitting geoid in terms of standard deviation and range of differences between gravimetric and GNSS/levelling geoidal heights.

Rigorous Evaluation of a Satellite-Only Gravitational Model

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Abstract

Presently, much work is being done in the field of geodesy on producing better gravita-tional models using purely space-based techniques. With the large datasets spanning a long timeframe thanks to the GOCE and GRACE missions, it is now possible to compute high quality global gravitational models in a convenient form: spherical harmonics. For regional geoid modeling, this is advantageous as these models provide a useful reference which can be improved with terrestrial observations. In order for these global models to be usable below the topographical surface, certain considerations are required; topographical masses cause the space below the surface to be non-harmonic which violates the mathematics inherently associated with solid spherical harmonics.

This paper aims to look at the error that is caused when the topography is not properly accounted for. It thus provides a more rigorous methodology that is well-suited for the Stokes-Helmert approach to high-precision regional geoid computation. A numerical investigation of various high-profile gravitational models is also included. Comparisons between the methodology proposed here and the generally used algorithm are made in order to study the error that is committed. With a range of 23.6 centimetres and a standard deviation of 0.8 centimetres, this is a non-trivial error if the ultimate goal is to compute a regional geoid with an accuracy of better than 1 centimetre.

Assessment of Performance of Current State-of-Art Tropospheric Mapping Functions: UNB-VMF1 vs VMF1

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Abstract

In this study, the issue of the tropospheric mapping functions (MF) employed for VLBI and GNSS data analysis is addressed. IERS conventions recommend, for standard operational solutions, the use of numerical weather models (NWM) to improve mapping functions applied in troposphere modeling. The Vienna Mapping Functions 1 (VMF1) map the atmospheric delay from zenith to the line of sight as an elevation dependent function and are capable of better accounting for real weather phenomena compared to MF without NWM input data.

However, the spatial resolution of the NWM itself, directly impacts the ability to model atmospheric conditions effectively. Therefore, we employ the UNB-VMF1 which utilize the high resolution model from the Canadian Meteorological Centre based on the Global Deterministic Prediction System (CMC GDPS). The latter, as a modern operational model, contains the latest application of atmospheric physics and parameterizations and is relieved from spatially based systematic effects.

For our investigations, we analyze all rapid turnaround VLBI experiments spanning the period from 2009 to 2014 using the VieVS@GFZ software, as well as the entire data set from IGS sites that observed at the same interval using UNB's PPP software GAPS. Using the inde-pendent UNB ray-tracing algorithm we derive hydrostatic and wet "a" coefficients of MF as well as zenith delays from ray-tracing in CMC NWM. The solutions we produced differ only in the choice of the mapping functions. The VLBI and GNSS analysis are fully consistent. The comparison is conducted on both global and local parameters (station positions and velocities, Earth rotation parameters, zenith wet delays and first order tropospheric gradients) between VLBI and GNSS derived products as well as between employing VMF1_ECMWFop and UNB-VMF1_CMC.

Proposing a Measurement-Based Geospatial Data Management System

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Abstract

This project aims to design and develop a data management system for Land Surveyors. A large component of Land Surveyors' duties are related to the collection and processing of geospatial data. Unfortunately, the data management procedures used by the majority of the land surveying industry inhibit the utility of existing data.

GIS is a system of geospatial data management; however, the limitations of conventional GIS make it unsuitable for the management of Land Surveying data. A Measurement-Based GIS concept was proposed in 2002 that appears much better suited to the Land Surveying Industry. Although attempts have been made to implement some of the MBGIS concepts into existing GIS packages, a true MBGIS system has never been implemented.

During the course of this project five system components will be designed and developed: An object-relational database, a Geodetic API, a database management system, a desktop client, and a mobile client. The database and database management system will adhere to MBGIS concepts. The Geodetic API will utilize existing geodetic techniques for measurement processing and error estimation. The database management system and both clients will build upon the API to allow for the integration and management of geospatial measurements.

The system created by this project will improve the efficiency of Land Surveying operations, providing benefits to the many industries that utilize geospatial data. The lessons learned from the implementation of this basic MBGIS system will provide a basis for creating a full MBGIS system to solve problems experienced by the GIS community.

No-Reference Perceptual Quality Measurement for Color Images

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Abstract

No reference image quality measurement techniques are commonly used to measure quality when reference image is not available. Apart from photography and videography, image quality measurements have been often used in remote sensing, image fusion and surveillance. Most of no-reference image quality measurement techniques are based on image statistics, noise profile, blur and distortion modeling. These methods are developed for gray images. They do not consider colors and their spatial distribution. Also, image statistics and distortions are spatially invariant which do not follow human vision system. A no-reference color image quality measurement technique is proposed in this paper which is independent of image statistics and distortions types. Images are spatially segmented and different segments are analysed in spatial and CIELAB color domain. Experiments prove that the proposed methodology gives no-reference perceptual image quality score which scores image quality based on colors and their spatial distribution whereas other no-reference methods are based on gray images and their statistics. Such score is useful to rate a referenceless individual color images, compare two or more independent color images, or a set of color images when their image statistics are similar and other methods are failed to differentiate them.

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