Graduate Seminar

&

Student Technical Conference

Wednesday March 24th, 2010

Thursday March 25th, 2010

Department of Geodesy and Geomatics Engineering

The organizers would like to welcome you to the

2010 Graduate Seminar & Student Technical Conference

Where:

Dineen Auditorium – C13

When:

Wednesday, March 24th 2010

Thursday, March 25th 2010

Please join for refreshments after the Conference in room C-9.

The reception is sponsored by McElhanney.

Seminar Organizers:

Alex Garcia and Sven Commandeur

with thanks to Sylvia Whitaker

Department of Geodesy and Geomatics Engineering

Geodesy and Geomatics Engineering

Graduate Seminar and Student Technical Conference

Dineen Auditorium – C13

Wednesday March 24th, 2010

02:30 PM	**Opening Remarks**
	Undergraduate Students
	Chair: James Mtamakaya
02:40 PM	The process of Wetland Delineations in New Brunswick
	John McKelvey
02:55 PM	Nunatsiavut Government Land Registry System
	Janeil Parrott
03:10 PM	Digital Survey Plan Review and Assessment for Electronic Submission
	Trevor D. F. MacDonald
03:25 PM	Comparison of Positions and Uncertainties obtained from GPS and GPS+GLONASS
	Benjamin d'Eon
03:40 PM	An Evaluation of Data Protocols used in Real Time Kinematics
	Robert C. Leiper
03:55 PM	**Coffee Break**

04:10 PM	Comparative Analysis of CAN-NET GNSS Positioning and Conventional surveying with respect to Legal Surveys *Conor F. McGuire*
04:25 PM	Qualifying for the Land Surveying Profession in Canada *Sophie-Rose Côté*
04:40 PM	Modern Trigonometric Height Traversing *John Gillis Gauthier*
04:55 PM	A Critical Analysis of the Deformation Monitoring for an Engineered Cover *Clifton Hawco*
05:10 PM	Investigating the Capabilities of General Packet Radio Service-Enabled Real Time Networks *Timothy Kevin Borylo*
05:25 PM	**Closing Remarks**

Geodesy and Geomatics Engineering

Graduate Seminar and Student Technical Conference

Dineen Auditorium – C13

Thursday March 25th, 2010

09:30 AM	**Opening Remarks**
	Graduate Students Paper Competition
	Chair: Krista Amolins
09:40 AM	Design and Implementation of a Coastal Collaborative GIS to Support the Management of Sea Level Rise Adaptation Strategies
	Titus Tienaah
10:00 AM	Antenna Rotation and Its Effects on Kinematic Precise Point Positioning
	Simon Banville
10:20 AM	Harmonic Analysis of Position and Observation Residuals on the reprocessed IGS Global Network
	James Daniel Mtamakaya
10:40 AM	Developing LiDAR Data Acquisition and Quality Assurance Specification for New Brunswick
	Patrick Adda
11:00 AM	**Lunch Break**

12:30 PM	**Opening Remarks**
	Undergraduate Students
	Chair: Krista Amolins
12:40 PM	The Psychological Effects of Maps
	John Thompson O'Neill
12:55 PM	Assessing the Vertical Accuracies of Photogrammetric Digital Terrain Models in the Greater Saint John Area
	Joseph A. Roberts
01:10 PM	Role of Coordinates as Evidence in Canada
	Blake Trask
01:25 PM	Optimizating supervised Classification of Colour Infrared Imagery with diverse Exposures
	Trisha Chapin
01:40 PM	**Coffee Break**

Undergraduate Students Paper Competition

01:55 PM	Modelling the Effect of Oceanic Internal Waves on the Accuracy of Multibeam Echosounders *Travis John Hamilton*
02:10 PM	A comparison of Airborne Technologies for DTM Production *Paul Sheldon Chisholm*
02:25 PM	Optimization of GPS in Ground Subsidence Surveys *Matthew McAdam*
02:40 PM	Use of single combined scale factor for legal survey plans in integrated survey areas in British Columbia *Rafael Rebolone*
02:55 PM	Wetlands and their influence on the profession of land surveying in New Brunswick *Joseph K. Chessie*
03:10 PM	**Graduate Students Paper Competition Awards**
03:25 PM	**Undergraduate Students Paper Competition Awards**
03:40 PM	**Reception**

ACKNOWLEDGEMENTS

Graduate Students Paper Competition Awards
&
Reception refreshments

Undergraduate Students Paper Competition Awards
1st place

Undergraduate Students Paper Competition Awards
2nd & 3rd place

THE PROCESS OF WETLAND DELINEATIONS IN NEW BRUNSWICK

John McKelvey
Supervisor: Dr. Susan Nichols

Abstract

Wetlands are becoming a growing concern in New Brunswick. The problem is that there is not enough known about what "wetlands" are and how to determine if an area is considered a wetland. These are common questions asked today by developers and by land owners. These areas need to be protected because they have a number of different environment benefits that humans and wildlife can enjoy. In this report, the goal is to have a better understanding of the definition of a wetland and how these areas are determined or delineated.

The purpose of this report is to study what a wetland is and what makes an area a wetland. An analysis of different types and classifications of wetlands, along with how these areas are being protected, in the province of New Brunswick will be made.

The report will then discuss the process involved in performing a wetland delineation in the province. This itself is a complex process relying on an advanced knowledge of biological sciences to properly conduct this process. The relationship between delineators and surveyors will also be reviewed based on interviews conducted.

Finally the report will recommend changes that can be made to the current wetland delineation process and how it is managed. There will also be an emphasis on the importance of protecting these areas but not necessarily eliminating all land use or development around wetlands.

NUNATSIAVUT GOVERNMENT LAND REGISTRY SYSTEM

Janeil Parrott
Supervisor: Dr. Susan Nichols

Abstract

The Labrador Inuit Association, in Newfoundland and Labrador, has recently formed their own government known as the Nunatsiavut government. The Nunatsiavut government was required, by legislation, to develop their own land registry system to administer the land they received from the Agreement in Principle, which arose from the negotiation between the Labrador Inuit Association, the Newfoundland and Labrador Government, and the Federal Government with regard to land claims.

The main objective of this research was to help to improve the Nunatsiavut Government Land Registry System. By reviewing the *Labrador Inuit Lands Act*, interviewing the staff from the Nunatsiavut Government Land Registry Office and conducting research showing why a land registry system was developed and what are the issues with parcel delaminating.

There are many issues with the development of the Nunatsiavut Land Registry System such as personnel, expertise, inaccurate data, inaccurate mapping, as well as acquiring and maintaining subsequent data. This report will assist the Nunatsiavut Land Registry System in acquiring and maintaining subsequent data with the personnel that they have in an affordable manner.

The specific objectives of this research are to: focus on designing an appropriate incremental system for collecting, managing and visualizing spatial information for the registry; find out how to acquire accurate boundary and surveying information, and how to accommodate various surveys (old surveys and the quality of that data). These objectives will make the registration system more efficient.

DIGITAL SURVEY PLAN REVIEW AND ASSESSMENT FOR ELECTRONIC SUBMISSION

Trevor D.F. MacDonald
Supervisor: Dr. David Coleman

Abstract

Land Surveying field procedures has changed drastically over the last 10 years with Global Positioning Systems, reflectorless total stations, robotic total stations, data collectors and the internet in which large amounts of information are transferred. As technology has made field work more efficient and productive for land surveyors, it has created a gap between when the fieldwork is completed and when a subdivision plan is actually approved and registered. With all the advancements in our field techniques and procedures, there is now a need to review the office workflow to minimize this gap.

This technical report summarizes investigations undertaken by the author to enable land surveyors to circulate and submit their electronic form of a subdivision plan. The main objective is to propose an efficient and cost effective way to review and submit a subdivision plan, while giving the reviewers of the plan (i.e., planners, engineers, land registry officers) the ability to add their comments and suggestions on the subdivision plan.

For this technical report, the author has researched the current subdivision approval process in Nova Scotia and New Brunswick through interviews and reviewing the acting regulations pertaining to subdivisions. This study also reviews existing electronic plan submission procedures in Canada. The completion of this technical report develops an electronic procedure to submit and circulate a concept, preliminary, tentative and final plan of subdivision, as in the case of Nova Scotia.

COMPARISON OF POSITIONS AND UNCERTAINTIES OBTAINED FROM GPS AND GPS+GLONASS

Benjamin d'Eon
Supervisor: Dr. Peter Dare

Abstract

GPS and GLONASS combine their systems to provide an increase in satellite availability and position accuracy. With the decline that GLONASS has had in its operational satellites, continuous worldwide coverage is no longer available.

GNSS receivers located all over world share GPS and GLONASS satellites. Receivers were chosen in various locations around the world and were used in an analysis to test whether positions obtained from GPS+GLONASS solutions provided improved accuracies and random uncertainties over GPS only solutions.

It was determined that GPS+GLONASS solutions can improve the position accuracy but the availability of satellites is so scarce that the majority of positions suffer a loss in accuracy when obtained using GLONASS satellites. For consistent and reliable positions worldwide, GPS+GLONASS solutions should be avoided until GLONASS has full operational capability with 24 satellites.

AN EVALUATION OF DATA PROTOCOLS USED IN REAL TIME KINEMATICS

Robert C. Leiper
Supervisor: Dr. Peter Dare

Abstract

There are two notable trends emerging within the geomatics services related industry:

1) The creation of networks of continuously operating reference stations (CORS) for private use, or for public use by subscription to the service. This has created a tendency of purchasers to want to buy rover equipment only.
2) Mixing GNSS equipment: different reference and rover receiver makes or models used jointly.

These trends are creating demand for a data protocol which can be used as an industry standard. The Radio Technical Commission for Maritime Services Special Committee No. 104 (RTCM SC-104) has published several standards to address this and other needs. Also, Trimble navigation has developed the Compact Measurement Record (CMR) format for this purpose.

These protocols operate at different bandwidths, which directly affect latency (the lag in positional information). It is the purpose of this paper to examine their effect on accuracy, relative to one another, in Real Time Kinematic (RTK) positioning.

An experiment was performed by the author in an attempt to reveal the magnitude of accuracy difference between the protocols, but this was not discernable from other errors. Recommendations for a modified experiment are given.

COMPARATIVE ANALYSIS OF CAN-NET GNSS POSITIONING AND CONVENTIONAL SURVEYING WITH RESPECT TO LEGAL SURVEYS

Conor F. McGuire
Supervisor: Dr. Peter Dare

Abstract

Methods of surveying have been changing over the past number of years. The newest product in the evolution of surveying is the use of Global Navigation Satellite System (GNSS). Conventionally with these systems, there is a need to set up a base station over a known control point in order to survey. Also, they are very expensive. There is now a new system available called Can-Net in which the user can connect to a base station which is constantly logging and processing data by means of the internet. Essentially what this does is "eliminate the need for a reference (base) station therefore reducing the initial startup cost".

Legal surveys in New Brunswick have certain specifications and standards which are set out by the Association of New Brunswick Land Surveyors (ANBLS) standards manual. For many years this manual was designed for surveying by conventional methods. Surveying methods evolved into using GPS/GNSS where possible, as it is more efficient. The Standards Manual now includes standards for this type of survey.

A comparative analysis of results of conventional and Can-Net GNSS surveying methods is carried out in this report. It will include a comparison of coordinate values, cost and efficiency. A conclusion as to which method may be a better choice when completing legal survey will be reached.

QUALIFYING FOR THE LAND SURVEYING PROFESSION IN CANADA

Sophie-Rose Côté
Supervisor: Dr. James Secord

Abstract

The Canadian model for the regulation of professional land surveying has evolved over the years and is influenced by internal and external elements and many different associations and committees. The internal elements are the process and criteria for evaluating, examining and licensing candidates of each land surveying association. The external elements are the regulating statutes that give the land surveying associations the right to set the entrance standards as well as regulate professional cadastral surveying. The role of associations and committees are to evaluate candidates based on these criteria.

This technical report compares the entrance standards for Canadian professional land surveyors and describes the current path to become a professional land surveyor in each jurisdiction in Canada. This report was written to give fellow students entering the profession or those interested in cadastral surveying as a career an overview of what academic and professional requirements that each Canadian land surveying association expects from candidates. To find the requirements, research of each land surveying association's publications on academic qualifications was done, the Canadian Board of Examiners for Professional Surveyors was researched and the legislation affecting the requirements for each association was researched. Finally, conclusions are made about the current state of entrance requirements to the land surveying profession.

MODERN TRIGONOMETRIC HEIGHT TRAVERSING

John Gillis Gauthier
Supervisor: Dr. James Secord

Abstract

Trigonometric height traversing can be a faster and more versatile method of transferring heights than both differential levelling and differential GPS methods. EDM equipped theodolites can operate without the hindrance of highly limited lines of sight and the need for open sky. Height traversing can be completed quickly and simultaneously with traditional horizontal traversing and topographic surveying, or all on its own. While past instrumentation has proven less than adequate for precision applications, the advent of new technology in electronic distance measurement and instrument level compensators have reopened the doors for investigation into the newfound abilities of transferring heights with a total station.

To test the abilities of modern total stations, two traverses were designed along first order levelling routes and repeated observation campaigns were undergone to determine the precision and accuracy capabilities of two separate instruments under varying terrain and atmospheric conditions. A new methodology of trigonometric height traversing has been described, an analysis of the data has shown optimistic results and specific cautions and recommendations for the future have been made.

A CRITICAL ANALYSIS OF THE DEFORMATION MONITORING FOR AN ENGINEERED COVER

Clifton Hawco
Supervisor: Dr. James Secord

Abstract

Deformation monitoring campaigns are performed as a means of describing the changes to a deformable body over time. In order for a deformation monitoring survey to be successful, the design of the methods and the procedures are crucial. The goal of this report is to analyze the methods and procedures of the deformation monitoring for an engineered cover and to give suggestions of methods and procedures which could have been more appropriate for the campaign.

The report includes an overall look at the deformation monitoring project from the initial location and installation of the monuments to the repeated measurements made to these monuments. The movement is then described and analyzed in order to give a description of the movement for the engineered cover.

INVESTIGATING THE CAPABILITIES OF GENERAL PACKET RADIO SERVICE-ENABLED REAL TIME NETWORKS

Timothy Kevin Borylo
Supervisor: Dr. Richard Langley

Abstract

Modern technologies have greatly improved the capabilities of real-time kinematic GPS positioning. The integration of active control into permanent networks allows for great distances and high precision to be acquired by users without the hindrance of carrying and setting up of equipment. The claims of manufacturers and service providers over time have been exposed as highly optimistic and inaccurate in real-world applications. To understand the true working capabilities of a system it becomes prevalent to test a system under the working environment.

The use of general-packet radio services within GPS networks allows for great distances and precisions to be stated. As with many technologies, the specifications can be assumed to be optimistic and therefore extensive testing is required to confirm or deny the allegations. Taking a system already in use and testing its capabilities will provide an effective means of determining the true capabilities of these types of systems. With that notion the technical report is an analytical comparison of real-world observations collected within a system of this type in order to decipher and interpret the collected data to prove or disprove the claims of the provider.

INTEGRATION OF SCIENCE AND LOCAL KNOWLEDGE FOR MANAGING SEA LEVEL RISE ADAPTION STRATEGIES IN A SPATIAL CONTEXT

Titus Tienaah

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Abstract

Current research in local ecological knowledge suggests a need to integrate quantitative (science) and qualitative (local knowledge) data to come up with methods for visualising and communicating this hybrid datasets as information. To develop a general purpose platform, a framework is required to visualise and communicate precision and imprecision. In this research a common platform will be developed to facilitate identification of vulnerable coastal communities to sea level rise, storm surges and other coastal impacts. It is important to harness local/traditional observations with scientific models to help coastal communities manage and design proactive adaptation strategies.

We will develop an approach to represent fuzzy and subjective local knowledge in a spatial context to facilitate integration with scientific knowledge on a Java platform. Local knowledge, science or both will be integrated on a cost effective, user friendly desktop and internet based GIS (uDig) to enhance spatial context visualisation (2D and 3D) and stakeholder interaction. The common platform developed will be used for managing local and scientific knowledge in sea level and coastal impact adaptation planning.

ANTENNA ROTATION AND ITS EFFECTS ON KINEMATIC PRECISE POINT POSITIONING

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Abstract

In an attempt to clearly understand the impacts of antenna rotation on the performance of GPS kinematic precise point positioning (PPP), this paper examines how unmodelled receiver antenna carrier-phase wind-up and antenna phase-centre variations (PCV) could propagate in PPP solutions.

The major concern with antenna rotation and PPP lies in the definition of the functional model. While receiver wind-up affects only carrier-phase measurements, both phase and code observables are typically used to estimate a single receiver-clock parameter which creates an inconsistency in the model. To solve this issue, a decoupled-clock model is reviewed and its usefulness is proven by showing that it could potentially avoid metre-level biases in the code residuals.

A link is also made between the mis-orientation of an antenna and the propagation of PCV errors in the positioning domain. It is shown that, depending on the antenna model used, centimetre-level errors could potentially contaminate the estimated coordinates.

HARMONIC ANALYSIS OF POSITION AND ANALYSIS OF POSITION AND OBSERVATION RESIDUALS ON THE REPROCESSED IGS GLOBAL NETWORK

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Abstract

Unambiguous, consistent and homogeneous GPS station coordinates are the fundamental requirement in the appropriate determination of geodetic velocities that are often used for the derivation of geodetic and geophysical models for a variety of applications. Because of this, there have been significant efforts in the past decade to improve the modeling and parameterization of global GPS solutions so as to get stable and homogeneous positions and velocities. As a parallel activity to these improvements, different spectral studies have been underway to examine various IGS solutions for different reasons**.** One of the recent improvements is the availability of new models for absolute antenna phase center variations (PVCs) that have been adopted by the International GNSS Service (IGS) since November 5, 2006 (GPS Week 1400). This has changed the IGS solution processing strategy and necessitated the reprocessing of all historical GPS data since 1994.

Based on the new IGS reprocessed solutions (REPRO 1), the primary motive of this research is to investigate and identify the short and long term effects of mismodeled and unmodeled errors from both known and unknown phenomena that are still impacting the new solutions. The investigation will use the Least Squares Spectral Analysis software (LSSA) to analyze on the reprocessed solutions and residuals as will be obtained from IGS via NRCan. The LSSA will as well be used to analyze long periodic signatures from lunar and solar tide effects which have to be generated from available algorithms as well as the atmospheric pressure as a way to establish possible correlation between them.

DEVELOPING LIDAR DATA ACQUISITION AND QUALITY ASSURANCE SPECIFICATIONS FOR NEW BRUNSWICK

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Abstract

Since 2001, at least four departments in New Brunswick have considered LiDAR data acquisition and processing as a suitable way of updating their spatial data. While some have acquired LiDAR datasets, others are strategizing as to how to cover the significant cost of purchasing the data. Where possible, sharing the cost makes sense. However, the different standards, accuracy, formats and end products produced can frustrate the sharing and integration of LiDAR datasets for multiple users.

Consequently, Service New Brunswick contracted GGE in December 2009, to provide minimum standards for LiDAR data acquisition and quality control for the province. The objective is to harmonize the technical methods for LiDAR data collection by setting minimum parameters, and estimating error budget requirements for raw LiDAR point cloud collection and processing. It also involves creating a web enabled inventory of LiDAR data capture across the province.

The challenge of this task involves negotiating acceptable technical standards among multiple departments, considering various user requirements. This goes beyond setting geodetic controls and geographic reference systems. It goes beyond uncertainty statistics and documenting common metadata. It goes beyond technical research into available LiDAR technology and systems. It involves open discussions and lobbying to deal with issues relating to data sharing, including data custodianship and right of access.

This presentation provides some findings on proposed specifications based on defining acceptable accuracies, processing and product deliverables. It accommodates various user requirements and allow for seamless integration of LiDAR data and related products into traditional data formats and workflows among multiple departments in New Brunswick.

THE PSYCHOLOGICAL EFFECTS OF MAPS

John Thompson O'Neill
Supervisor: Dr. James Secord

Abstract

Maps, as a complex communication tool, can often lead to miscommunication. Though miscommunication is acceptable at a certain level, when significant, it can have various adverse effects. It is the trusting relationship that we have with maps that allows us to have significant psychological effects. For example, propaganda maps, from Germany for example, may have caused the people to have an altered perception of reality. For maps to be a useful tool, we should be able to trust them. This means that as cartographers, we must have a firm understanding of the limitations of the various cartographic tools we use. As a communication effort, there are two sides. The mapmaker should make efforts to avoid causing people to have false ideas about the world. At the same time, those who read maps should be discerning and make an effort to understand the purpose of the map and base opinions on maps by professional, ethical sources. Cartographers must also be vigilant that the distinction between professional and amateur maps is clear. Though maps have many limitations, with the proper knowledge, they are indispensable tools of human ingenuity.

ASSESSING THE VERTICAL ACCURACIES OF PHOTOGRAMMETRIC DIGITAL TERRAIN MODELS IN THE GREATER SAINT JOHN AREA

Joseph A. Roberts
Supervisor: Dr. James Secord

Abstract

Digital Terrain Models (DTMs) represent topographical information of a certain desired area of the Earth's surface, composed as a mass collection of points with three dimensional coordinates. This data can be particularly useful to land owners, municipalities, land-use planners, environmental groups, engineers, land surveyors, and land developers, along with many others. Ortho-photography is a common basis for the development of DTMs. Land developers, coupled with land surveyors, can use this data for several applications. The ortho-photographs can provide an overall illustration of prospective lands, as well as the identification of potentially sensitive areas, while DTMs aid in the preliminary design stages of subdivisions and other development. Contours can be generated from DTMs, assisting in generating grades and cross sections of potential roads and land parcels. However, these groups may require knowledge of any limitations or uncertainties that are associated with this data. Communication with respected members of the land surveying industry has revealed that the horizontal component of these data bases have been proven quite reliable; however, they do not have an opinion as to the accuracy of the vertical component. This project will quantify the vertical accuracy of two DTMs, which are commonly employed in this industry, over several test sites, and report on the affiliated limitations.

The first DTM is the 1:10,000 Digital Topographic Data Base available free of charge online from Service New Brunswick. The second is supplied for a fee from the municipalities in the Greater Saint John area, who contracted out the photogrammetric data collection and DTM generation. Coupling knowledge and acquired skills with examined sets of standards for the determination of map accuracies, the vertical accuracies of these DTMs will be obtained. The results will offer an insight for users into the reliability of the topo-graphic information, and this may guide them as to how to apply the data.

ROLE OF COORDINATES AS EVIDENCE IN CANADA

Blake Trask
Supervisor: Dr. James Secord

Abstract

The usefulness and availability of coordinates is becoming increasingly easier due to technological advances in coordinate systems and instrumentation. Historically, coordinates were considered to be the lowest form of evidence when dealing with cadastral surveying. With these advances in technology, the long-continued controversy of allowing horizontal coordinates to define property corners quite possibly could come to an end. There is still some debate to think about, mainly being the public's opinion and the legal issues surrounding this ongoing argument. Lawyers and judges follow established common law to rule on boundary disputes brought to court because coordinates are regarded as nothing more than a subordinate or supplementary method of describing boundaries.

Throughout the 11 jurisdictions in Canada, coordinates are presently being utilized in several ways. Some provinces give specific statutory rights to coordinates, whereas some provinces employ the use of coordinates without written legislation. Each of these aspects is discussed in this technical report.

Coordinates are a great new source of evidence to be considered when sufficient control and instruments have been used to acquire 2D positions of property monuments. The public's view in the end is what should be the deciding factor for cadastral coordinates to be highest in the hierarchy of evidence. It is them that will ultimately bear the benefits or damages incurred by giving coordinates more weight in the hierarchy of evidence.

OPTIMIZATING SUPERVISED CLASSIFICATION OF COLOUR INFRARED IMAGERY WITH DIVERSE EXPOSURES

Trisha Chapin
Supervisor: Dr. Kevin Pegler

Abstract

At CFB Gagetown, New Brunswick, there is a severe sedimentation issue in the Range and Training Area that is affecting the water quality and environment in the area. Using high-precision colour infrared imagery the different land cover classes were determined using a supervised classification. The problem at hand is that the imagery that has been collected has an extreme exposure variation within each image and within the entire image set. The purpose of this technical report is to generate a supervised classification that classifies the entire image set simultaneously regardless of exposure variation to help solve the sedimentation issues at CFB Gagetown.

MODELLING THE EFFECT OF OCEANIC INTERNAL WAVES ON THE ACCURACY OF MULTIBEAM ECHOSOUNDERS

Travis John Hamilton
Supervisor: Jonathan Beaudoin

Abstract

When ray tracing is performed on MBES data, it is assumed that the varying layers of sound velocity lie along horizontally stratified planes. In many areas internal waves occur at the interface where the water's density makes an abrupt change (known as the pycnocline). The internal wave introduces uncertainty into the soundings through two mechanisms: by tilting the pycnocline and by causing the pycnocline's depth to oscillate. The purpose of this research is to create a software tool that is able to model how internal waves affect the accuracy of MBES measurements. The software created for this research is capable of simulating the soundings from an MBES of a synthetic flat seafloor had they been collected through a user defined internal wave. The simulated soundings are used to determine the expected uncertainties introduced from the two separate mechanisms.

With this software, a case study is performed using observed internal waves on Banquereau Bank. The case study is used to analyze how certain survey design parameters such as line spacing, direction of survey lines, and water column sampling density can influence the uncertainty introduced by internal waves. The potential improvement incurred from an augmented ray trace, which accounts for the oscillating depth of the pycnocline across the swath, is also examined. This is under the assumption that the pycnocline can be tracked using water column imaging with swath sonars.

The investigation shows that internal waves have the potential to cause vertical uncertainties exceeding IHO standards; however, they can be mitigated through appropriate survey design.

A COMPARISON OF AIRBORNE TECHNOLOGIES FOR DTM PRODUCTION

Paul Sheldon Chisholm
Supervisor: Dr. David Coleman

Abstract

Large-scale digital terrain models (DTMs) are widely used in highway design and construction. DTMs often incorporate the elevations of important topographic features in an area of interest and provide a detailed characterization of the true shape of the bare Earth terrain. The net result of DTMs is detailed terrain features are more visibly defined and accurately located. Contours can subsequently be generated to closely approximate the true surface of the terrain of interest.

DTMs can be generated using data collected by numerous methods. This report presents some results of a recent study of a highway design project where three methods of data collection were utilized. These methods are airborne LiDAR (Light Detection and Ranging), aerial photography, and ground GPS and total station topographic surveys. A quantitative analysis was prepared to evaluate the relative and absolute accuracy of a LiDAR-derived DTM compared to those generated by photogrammetric means and to ground topographic survey data. This was achieved by performing statistical and visual analyses as well as by examining the associated errors of each method.

With an analysis of the accuracies achieved by each of the airborne data collection methods, the extent to which the DTMs could be used in the design process is demonstrated, thus defining where ground survey methods are necessary.

OPTIMIZATION OF GPS IN GROUND SUBSIDENCE SURVEYS

Matthew McAdam
Supervisor: Dr. Adam Chrzanowski

Abstract

Ground subsidence surveys have traditionally required geodetic levelling techniques of the first order to achieve meaningful subsidence values. Geodetic levelling with a precision spirit level and invar rods is a necessary, time consuming and labour intensive activity. With the advent of the Global Positioning System (GPS) as an acceptable survey technique, its suitability to ground subsidence surveys has been considered. The focus of this investigation is on the application of GPS in ground subsidence surveys with respect to the determination of changes in height over time. The effectiveness of GPS in subsidence surveys has been evaluated through the comparison of changes of GPS height differences (vertical displacements) to those by geodetic levelling, the traditional method of subsidence monitoring, such that the accuracy of the GPS survey is estimated. Data is sourced from real world surveys originating from annual monitoring surveys of ground subsidence at the PCS Potash mine in Sussex, N.B., and encompasses three campaigns, 2006, 2008, and 2009. Comparisons span three, two, and one years to gage suitability to long-term and short-term feasibility. GPS baselines have been processed and adjusted as a network using commercially available software and coordinate differencing to establish the vertical displacements. The results indicate that GPS in ground subsidence surveys, using dual frequency antennas and standard field and processing practices, can achieve an accuracy of 10 mm at the level of one standard deviation for short baselines (up to 10 km) in relatively flat terrain and moderate climates. Optimizations to network configuration, field procedures, and post processing parameters are made such that the height determination is improved.

USE OF SINGLE COMBINED SCALE FACTOR FOR LEGAL SURVEY PLANS IN INTEGRATED SURVEY AREAS IN BRITISH COLUMBIA

Rafael Rebolone
Supervisor: Dr. Marcelo Santos
Co-supervisor: Dr. James Secord

Abstract

Plans in “Integrated survey” areas in British Columbia require the surveyor to provide a “combined scale factor” composed of the sea level reduction and the UTM point scale factor to reduce ground distances to the UTM plane. This scale factor is applied to all distances rather than calculating unique scale factors for each distance as would be the preferred method. In areas with large changes in elevation or surveys that cover large East/West distances, following this practice could lead to errors that could affect the integrity of a survey.

To investigate the limitations of a single combined scale factor, a fictitious traverse has been created spanning from the west coast near Vancouver, British Columbia to the central part of Southern Alberta. Calculating and applying scale factors to derived ground distances of the short legs of the traverse will form the base from which to compare the performance of the same process when performed on larger distances. This choice gives a great opportunity to see the effects of long distances, areas near sea level, areas with high elevations having dramatic changes in those values, and as we enter Southern Alberta, areas with high elevation but gradual change in topography.

The model shows the striking relationship between large distances and varying elevation with the limitations on the use of a single combined scale factor. The data obtained from the model is implemented to define functions to help a surveyor estimate the maximum length of line encompassed by one plan to reduce errors from UTM distance calculations.

WETLANDS AND THEIR INFLUENCE ON THE PROFESSION OF LAND SURVEYING IN NEW BRUNSWICK

Joseph K. Chessie
Supervisor: Dr. Susan Nichols

Abstract

As environmental concerns continue to grow, more emphasis is being placed upon protecting areas of ecological value. Although once classified by many government agencies as waste land, wetlands have entered the spotlight as some of the most valuable, fragile, and most heavily regulated environmental features in the province of New Brunswick. Currently, surveyors in the province, while recognizing the need for environmental consciousness, are experiencing some difficulties associated with the conservation efforts on wetlands since they work in a profession heavily dependent on development. The major issue seems to be a general lack of available information pertaining to the topic. As information is limited, relevant case studies as well as personal correspondence were critical in completing this report.

This report provides the geomatics industry with a detailed summary of wetlands and how they are classified in New Brunswick. It includes information pertaining to wetland identifiers, current wetland delineation practices, and existing regulations and legislation used to regulate development near wetlands and watercourses. It also presents the current status of existing wetland spatial data resources, and many of the issues surrounding the relationship between wetlands and the associated responsibilities and potential liabilities of land surveyors in the Province of New Brunswick. The report outlines the preliminary framework for an integrated spatial data infrastructure to manage wetland location and attribute data, similar to or incorporated with the current *PLANET* cadastre. Further research into such a system is recommended for the near future. Finally presented is the current position of the ANBLS, its leadership role in educating the membership and how it is taking the necessary steps to initiate a solution to many of the relevant issues.

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