Graduate Seminar

&

Student Technical Conference

Friday, April 5th, 2013

Department of Geodesy and Geomatics Engineering

The organizers would like to welcome you to the

2013 Graduate Seminar & Student Technical Conference

Gillin Hall

D-108

With reception to follow

Head Hall

E-4

Friday, April 5th 2013

Seminar Organizers:

Emad Mousavi & Andrew Kubiak

With special thanks to Sylvia Whitaker & Michelle Ryan

Department of Geodesy and Geomatics Engineering

Geodesy and Geomatics Engineering

Graduate Seminar & Student Technical Conference

Gillin Hall • Room D-108 • Friday, April 5th, 2012

8:55 AM Opening Remarks, Seminar Organizers

Session 1 **Chair, Andrew Kubiak**

9:00 AM Automation of military convoy route selection
JONATHAN FUDGE

9:20 AM Tracking and visualization of real-time trajectories: a case study of the city of Fredericton bus transit
ADEGOKE LAWAL

9:40 AM Grand Lake Meadows since the 17th century: a mapping and awareness project
HEATHER MCGRATH

10:00 AM Visualization and knowledge discovery of moving object data
SABARISH MUTHU

10:20 AM Mining and disseminating the content of historical map collections
MARIA ZANNI

10:40 AM Coffee Break

Session 2 **Session Chair, Emad Mousavi**

11:00 AM Remote sensing of opium poppy fields using EO-1 hyperion hyperspectral data
JIANJUN WANG

11:20 AM Enhanced target recognition from unmanned aerial vehicles (UAVs) using thermal and daylight cameras
DENISE SWEET

11:40 AM Empirical validation of large datasets – the LiDAR experience
PATRICK ADDA

12:00 PM Remote sensing of opium poppy fields using EO-1 ALI multispectral data in Helmand, Afghanistan
JIANJUN WANG

12:20 PM Improvements in multibeam echo sounder sonar data integration
TRAVIS HAMILTON

12:40 PM Developing spectral analysis tools for quantitatively determining riverbed roughness
DANAR PRATOMO

01:00 PM Discussion and Closing Remarks
01:15 PM Presentation of awards
01:30 PM Reception being held in E-4, Head Hall

ACKNOWLEDGEMENTS

Graduate Student Paper Competition Awards

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Automation of military convoy route selection

Jonathan Fudge

Supervisor: Dr. David Coleman

Abstract

Selecting a proper route for moving vehicles is a necessary step during the planning stages of any convoy task. In addition to the expected attributes of distance, maximum speed, and driving time; there are several other factors that need to be addressed for military operations. Traditionally these tasks are completed manually, with little thought towards automation. Therefore, the development of a planning tool using widely available geoprocessing techniques became an attempt to provide a faster method to help determine appropriate routes.

In addition to the previous attributes, factors such as the weight capacity of a route, location of obstacles, and a risk analysis must be utilized to determine a given routes usability. The first portion of the project involved determining those factors which lend themselves to a quantitative approach to allow for classification. The Python programming language was utilized as it allowed for multiple attributes to be looked at, in addition to its interoperability with ArcGIS. Once the classification process was completed it was necessary to determine the locations of start and end points, along with any obstacles along the routes, as well as convoy information. This was completed using several shapefiles and tables. Together all this data would be used to compute the shortest route. This calculation was performed using the Network Analyst extension of ArcGIS through Python, which was deemed the most appropriate as it is the program used by the Canadian Forces. As route data is constantly being updated the use of Python allows for scenarios to be executed quickly using the most to date information.

Tracking and visualization of real-time trajectories: a case study of the city of Fredericton bus transit

Adegoke Lawal

Supervisor: Dr. Monica Wachowicz & Emmanuel Stefanakis

Abstract

Currently in the City of Fredericton, public transit schedules are disseminated through lists of bus routes, grids of bus stop times and static maps. However, the spectrum of Google web mapping technology offers a useful tool set to present transit information using high resolution satellite images, 3-D buildings and road network data layers for disseminating the information of the real-time trajectories of the bus transits. This paper presents the use of GPS data and web mapping application to track and visualize the real-time trajectories of a bus transit to provide a dynamic context for disseminating the information about the actual arrival times of a bus transit. With the aid of a hand-held Garmin GPS Map 76CSx, real-time trajectories of a particular bus of Route 16 (Kings Place to Regent Mall/ Regent Mall to Kings Place) out of the eight working bus routes which operates in the City of Fredericton were collected on a six day period during the morning and evening peak hours (three days in summer season and three days in fall season). The visualization was done by using Google Earth plug-in, Google Map API V3, Google Visualization API, JavaScript, PHP, Apache web server and Python scripting. From the web application, the results are promising towards generating new public transit services and from the real time trajectories the results show the difference between the actual arrival times and the scheduled arrival times for Route 16. Finally, an evaluation of the disadvantages and advantages of using the Google technologies to visualize bus transit information were considered.

Grand lake meadows since the 17th century: a mapping and awareness project

Heather McGrath

Supervisor: Dr. Emmanuel Stefanakis

Abstract

Looking at a historical map gives us a snapshot into the past and is one way to understand information about a location's history. If we can look at a collection of maps which span several centuries we will have a better understanding of the evolution of land use and habitation of an area, as well as its historical significance. That is the goal of this research: to delve into historical map collections and identify changes in land use within Grand Lake Meadows wetland, documenting the socio-economic and geomorphological evolution of the area, and to share these findings. Grand Lake Meadows is the largest freshwater wetland in New Brunswick encompassing 165km2 and is classified as a Class II Protected Natural Area. Wetlands are important resources and there is great need to preserve them: for temperature moderation, water purification, for the sake of wildlife habitat, and to maintain a reasonably balanced ecosystem. The maps along with historical information acquired through the Grand Lake Meadows Project Management Committee and Queens County Heritage will lead to the development of an educational web-based map mashup application which will enhance awareness of the historical significance of this region for both school students and adults, with the aim of promoting an informed balance between human activities and the natural environment in order to preserve the ecological integrity of the wetlands. The map mashup web application will be enriched with background maps (e.g. Google Maps, Service New Brunswick) via Open Source software (i.e. Open Layers).

Visualization and knowledge discovery of moving object data

Sabarish Muthu

Supervisor: Dr. Emmanuel Stefanakis

Abstract

This research aims to develop a prototype system for the visualization and knowledge discovery of moving object data over the Web, in particular, moving ships using historic AIS data. The historic dataset obtained from the Marine Traffic project consisted of 1,039,634 records, where the movements of 3,144 ships were recorded during August 2012. This dataset was used as an input to develop the system. First, trajectories of the vessels are reconstructed from the sample points. Second, a Moving Object Database (MOD) is constructed and populated with the trajectories and other non-spatial ancillary information associated with these trajectories. Third, knowledge discovery and detecting outlier methods on the moving vessels are incorporated into the system. Fourth, geospatial Web services are created which would facilitate in the dissemination of geographic data, thus providing efficient framework for the management and monitoring of the moving vessels. The system architecture consists of a PostgreSQL database with its spatial extension, PostGIS. The database stores the position of the moving ships as latitude-longitude coordinates and functions are built in to construct the trajectories from these coordinates. GeoServer, which acts as a GIS Server is used for geodata management and for map rendering. The entire application is written using the Web scripting language, PHP.

Mining and disseminating the content of historical map collections

Maria Zanni

Supervisor: Dr. Emmanuel Stefanakis

Abstract

Historical maps are a significant and integral component of a nation's cultural heritage as they store valuable geographic and historical information. The information that historical maps contain can be usable in several domains, (history, culture, education), as the maps depict the spatiotemporal evolution of the entities illustrated therein. In order to be able to use and extract information effectively from historical maps, they should be semantically documented. The semantic documentation can be a way of restoring any ambiguities and structuring the relationship between the present and the past geographic space.

The Provincial Archives of NB and the UNB Archives maintain a rich collection of historical maps which date back to the 17th century. The scope of the proposal, after searching and finding representative examples of historical maps in the above two archive collections, is to develop appropriate methods and tools to extract useful knowledge from historical maps. The research will be focused on the historical maps for two areas of the province: a) Mactaquac Dam and b) Kouchibouguac National Park and based on their content the socioeconomic and geomorphologic evolution of these areas will be discovered and disseminated in an interoperable way.

This paper presents in a stepwise manner the actions taken in order to fulfill the objectives of the proposal. The first part presents the steps in general, briefing succinctly over the tools used within and the expected outcomes of the steps. The second part covers each step in a more extensive manner, leading to the final outcome, the creation of a Web Portal providing an interface and tools for the creative dissemination of historical information and content of maps collected mainly from the aforementioned Archives.

Remote sensing of opium poppy fields using EO-1 hyperion hyperspectral data

Jianjun Wang

Supervisor: Dr. Yun Zhang

Abstract

Each year, opium makes tens of thousands of people lose their lives; meanwhile, opium also leads to poverty as well as other serious social problems worldwide. However, in situ detection of opium poppy fields is often expensive, time-consuming and even quite dangerous in some regions like Afghanistan, the primary illicit opium producer in the entire world since 1992. To overcome the constraints of inaccessibility of poppy fields, high-resolution images like IKONOS have been applied by some organizations such as United Nations Office on Drugs and Crime. However, these high-resolution images are too expensive, especially when they are used to monitor a huge area. In contrast, much less expensive satellite hyperspectral data provide almost continuous spectra of targets and backgrounds, which may increase the detection capability of pixel and subpixel size targets. However, until now, no research publications have been found that identified opium fields from aerial or satellite hyperspectral images. Therefore, this study attempted to apply an EO-1 Hyperion hyperspectral image, which is free of charge, to detect poppy fields in a study area located in Helmand Province, Southwest Afghanistan. It was found that, by using a newly proposed methodology, poppy fields could be detected and poppy fraction values could be determined directly from the Hyperion image, even if only little prior knowledge of the study area was available. This is important for the area of inaccessibility. To further test the newly proposed methodology, more study areas will be involved in future research.

Enhanced target recognition from unmanned aerial vehicles (UAVs) using thermal and daylight cameras

Denise Sweet

Supervisor: Dr. David Coleman

Abstract

Small UAVs are an economical data collection tool which, with the increasing demand for real time coverage of major events such as natural disasters, is quickly gaining the attention of numerous sectors. Their use eliminates the risk and limitations associated with traditional pilots, allowing for longer reconnaissance missions in potentially dangerous conditions. The main objective of reconnaissance is to accurately identify objects of interest to aid in the decision making process. Standard visual cameras produce visually pleasing products that untrained users can innately understand, unfortunately, this imagery often does not provide adequate information to clearly depict targets of interest such as occupied facilities. These objects are readily detected by thermal imagery, however the resulting imagery is more difficult to interpret. Therefore, the development of merging techniques for visual and thermal imagery, gathered by small UAVs, was a crucial step in increasing the ability of untrained users to identify targets of interest.

While keeping in mind the computational and physical limitations of small UAVs, several of the standard image merging methods used for pansharpening were investigated and adapted in order to merge visual and thermal imagery in an intuitive and visually pleasing manner. A hue, saturation, value and an arithmetic addition method were developed and produced good results when evaluated using open source software and hardware suitable for use on small UAVs. The final thermally enhanced imagery maintains the natural and visually pleasing appearance of the true color imagery while providing users with the thermal information in a manner even an untrained user can immediately understand.

Empirical validation of large datasets – the LiDAR experience

Patrick Adda

Supervisor: Dr. David Coleman

Abstract

This paper discusses the challenges involved in determining the accuracy of large spatial datasets using airborne LiDAR data as an example. After the design of user specifications and a subsequent data delivery from the client based on the initially agreed specifications, field measurements and statistical analyses are undertaken to verify whether or not a user's specifications have been met.

Two major problems were encountered: namely, problems with some parts of the acquired data (error from the vendor), and problems with the field validation data acquisition process (error from the client or validator). Encountering these problems led to questions on the implications of these errors on accurate spatial data delivery. Using ALS data as an example in this study, it was found that results from employing incorrect data and/or procedures like post processing kinematic - where it is not possible to observe if a *fixed* solution was achieved after resolving the integer phase ambiguities - in the creation of spatial products can be up to one metre in elevation errors in general. It was, however, found that in areas clear of obstructions the erroneous process employed produced a mean RMSE error of 11 cm when compared to the superior network RTK method which has a RMSE of 1 cm to 5 cm. Areas with light and dense obstructions produces mean RMSE of 0.75 cm and 1.09 cm respectively.

More research is recommended to estimate the effects of these obstructions on GNSS measurements, but this paper provides initial empirical evidence of the effects of employing such erroneous data or processes to validate large datasets like LiDAR.

Remote sensing of opium poppy fields using EO-1 ALI multispectral data in Helmand, Afghanistan

Jianjun Wang

Supervisor: Dr. Yun Zhang

Abstract

Fighting against the opium producing effectively requires timely and accurately detection of poppy fields. To overcome the constraints of inaccessibility of poppy fields in some countries like Afghanistan, high-resolution multispectral satellite images have been used. However, their high prices prevent them from working for a large area. This study attempted to compare free EO-1 ALI multispectral data with Hyperion hyperspectral data in detection of poppy fields in a study area located in central Helmand, Afghanistan. It was found that ALI multispectral data could not produce accurate detection of poppy fields, and number of poppy fields was largely underestimated. A comparative analysis demonstrated that Hyperion hyperspectral data performed much more effectively than ALI multispectral data although the same methodology was applied.

Improvements in multibeam echo sounder sonar data integration

Travis Hamilton

Supervisor: Dr. John Hughes Clarke

Abstract

If any observations during a multibeam sonar survey are externally logged or erroneous, the need to recalculate a final sounding position of each beam arises. Due to an assumption that the transmit and receive arrays are co-located, the current Ocean Mapping Group algorithms introduce biases into the sounding positions. With the current algorithms, correcting datasets for externally logged or erroneous observations is no longer possible as biases introduced by the algorithm can be larger than the errors being corrected.

New algorithms have been developed which now account for separation between transmit and receive arrays. The new algorithms are realized by breaking down a three dimensional problem of calculating the intersection point of two non-concentric and refracted cones with the seabed, to a two dimensional problem of intersecting two hyperbolas on a plane of a defined depth. Through an iterative process the depth of the plane which produces a calculated two way travel time (twtt) that matches the measured twtt is determined. The iterative process partitions the twtt into a one way travel time (owtt) from the transmit array to the seabed, and a owtt from the seabed to the receive array. As a by-product the iterative process also calculates the geographic direction (azimuth and depression angle) in which a beam leaves the transmit array. Using the direction and owtt a ray-trace can be performed to calculate the geographic location of any sounding. A multibeam survey of a sand wave field near Trial Islands B.C., in which the mount locations of the arrays were erroneously set in the installation parameters, is used to assess the performance of the new algorithms. The Trial Islands survey is processed using both the old and new algorithms to demonstrate that the new algorithms allow us to correct a previously unfixable survey.

Developing spectral analysis tools for quantitatively determining riverbed roughness

Danar Pratomo

Supervisor: Dr. John Hughes Clarke

Abstract

Riverbed roughness reflects relief at horizontal and vertical scales that are a small fraction of the width and the depth of the river respectively. A correct characterization of the spatial distribution and dimensions of the roughness is required to aid in understanding, assessment and prediction the sediment dynamics and hydrodynamic processes in the river and its vicinity.

This research implements a two dimensional (2D) spectral analysis tools which is applied to multibeam data to characterize the riverbed roughness quantitatively. A 2D spectral analysis was exercised using a sliding 64 × 64m window through a 0.25m resolution digital terrain model. The most energetic peak of the 2D spectrum was found and its wavelength, magnitude and azimuth were calculated. To achieve this, the isotropic component of the roughness needs to be calculated and removed to emphasise the anisotropic (directional) roughness. The most energetic residual peak represents the most common wavelength in the area. The bed-form orientation is associated with the direction of sediment transport, whereas the wavelength and azimuth are associated with the flow depth and flow speed.

Further refinements that are being considered including quantifying the wavelength and azimuth variability and the possibility of defining secondary spectral peaks. The ultimate aim of this research is to determine the correlation between the temporal evolution of riverbed roughness and active hydrodynamic process including river discharge and variation from spring to neap tides.

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