Geomatics Innovation @ UNB

Winter 2019

Thursday, March 28th, 2019

Friday, March 29th, 2019

The Department would like to welcome you to the

Winter 2019 Geomatics Graduate Seminar

When:

Thursday, March 28, 2019 at 1:30 pm

Friday, March 29, 2019 at 12:45 pm

Where:

Head Hall – Room E-11

Department of Geodesy and Geomatics Engineering

Winter 2019
Geomatics Graduate Seminar

AGENDA

Thursday, March 28th 2019

Chair: Ryan White

1:30	**Opening Remarks**
1:35	**Guest Speaker: Dr. Shabnam Jabari, UNB-GGE**
1:45	**CubeSat NB: GNSS Payload Development** *Heather Nicholson (MScE; year 4)*
2:05	**GNSS Signal Quality Monitoring for Multipath Detection in Urban Areas** *Ivan Smolyakov (PhD; year 4)*
2:25	**Influence of Reflection on 3D Laser Scan Intesity Value** *Enuenweyoi Daniel Okunima (PhD; year 4)*
2:45	**Infrastructure-Centred Autonomous Vehicle System** *Emerson Pereira Cavalheri (PhD; year 4)*
3:05	**Closing Remarks & Best Presentation Award** *Refreshments provided.*

Winter 2019
Geomatics Graduate Seminar

AGENDA

Friday, March 29th 2019

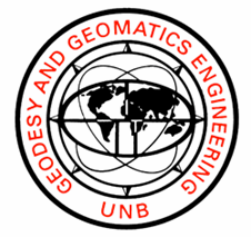
Chair: Ariel Martinez Salas

12:45	**Opening Remarks**
12:50	**An IoT Platform for Occupancy Prediction using a Hybrid Ada-SVM Algorithm** *Alec Parisé (MScE; year 2)*
1:10	**Synergizing Batch & Stream Analytics for IoT Data** *Hung Cao (PhD; year 3)*
1:30	**An Evaluation of Model Data for Computing Sound Velocity Profiles in Shallow Arctic Waters** *Khaleel Arfeen (MScE; year 2)*
1:50	**Noise Characteristics of GNSS Coordination in a Volcanic Region** *Gozde Akay (PhD; year 9)*
2:10	**Closing Remarks & Best Presentation Award** *Refreshments provided.*

Winter 2019 Geomatics Graduate Seminar

ABSTRACTS

You may contact the Authors for a copy of the full papers.



Department of Geodesy and Geomatics Engineering

CubeSat NB: GNSS Payload Development

Heather Nicholson

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Abstract

A CubeSat is a miniature satellite that measures 10 cm^3 per unit and was developed as a way to provide students with an affordable, hands-on experience in space exploration. Building on the success of prior CubeSat initiatives, the Canadian CubeSat Project was announced in 2017 by the Canadian Space Agency as an exciting endeavor to provide Canadian post-secondary students with a hand-on project that will help develop student's experience in space science and technology. The Canadian CubeSat Project team from New Brunswick, CubeSat NB, is a collaborative project between the University of New Brunswick, the Université de Moncton, and New Brunswick Community College. From the University of New Brunswick, several graduate students in the Department of Geodesy and Geomatics Engineering are part of the CubeSatNB design team.

As the project is just entering the early design phase, this paper will focus on the pre-design phase of the GNSS payload planned for the CubeSatNB project. This will include a discussion of the mission objectives, design specifications and requirements, selection of the GNSS payload components, and suggested pre-mission testing. The conclusion will focus on future work to be done and general recommendations as the project moves forward.

Infrastructure-Centred Autonomous Vehicle System

Emerson Pereira Cavalheri

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Abstract

Autonomous vehicles (AVs) developments have a major challenges of the lack of safety and scalability of their products. On specific situations, AVs cannot assure total safety because of the multiple agents involved in an accident and in real driving scenarios. As the technology in communication (V2I and V2V), mapping, and cloud based services exponentially advances, architecting a safer and scalable autonomous system first requires the design of a general purpose reference architecture, however a few examples are offered as of beginning of 2019. The need to rethink and plan how the infrastructure will accommodate for the smart vehicles is required. In this contribution, a review of two studies of unified approaches is explored. From the review, a new infrastructure-centred autonomous vehicle system will be proposed. The main characteristics of this system is safety, based on central rules, and easy scalability. Because of the centred feature of the system, the major concerns are in the load of processing, which would pose challenges to current modern IoT systems.

Influence of Reflection on 3D Laser Scan Intensity Value

Enuenweyoi Daniel Okunima

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Abstract

Reflective surfaces (e.g. mirrors) can facilitate 3D laser scan documentation of objects in locations that are hard-to-reach or where it is impracticable to set up the laser scanner due to limited room or safety concerns. The intensity information captured by the laser scanner during the documentation process has proven to be useful in several applications including object detection, data registration, feature extraction, classification, and surface analysis. Therefore, the purpose of this study was to investigate the influence of a mirror's reflection on the laser scan intensity information.

In this study, one 18% reflectance gray photography calibration card and one 90% reflectance white photography calibration targets were affixed to the front and rear sides of a box. The box was placed on a pivot in front of a mirror and the laser scanner was set up 4m away from the pivot to scan the targets. The box was rotated around the pivot in increments of 15° up to 30° on both sides of the pivot. This procedure was repeated with the laser scanner placed 8 m and 12 m away from the pivot.

The results from the study show that the intensity values of all targets increased with distance from 4 m to 8 m but decreased from 8 m to 12 m. Furthermore, reflection reversed the pattern of variation of the intensity values with the orientation angle in the front gray and white targets. Finally, the reflected intensity values were different from the direct intensity values.

GNSS Signal Quality Monitoring for Multipath Detection in Urban Areas

Ivan Smolyakov

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Abstract

The Signal Quality Monitoring (SQM) multipath detection is implemented to detect and further exclude or de-weight the multipath-contaminated GNSS measurements to minimize the impact of multipath-induced errors on the navigation filter performance in urban areas. Based on a real-world dataset analysis, a single-tailed significance test is designed. Two SQM metrics, code-minus-carrier (CMC) and carrier-to-noise-density ratio are considered for multipath detection. The algorithm performance is evaluated with a kinematic dataset collected with mass-market GNSS equipment. The proposed technique decreased the average absolute horizontal error by 30 cm, eliminated the instances of 10 m horizontal and 20 m vertical absolute error jumps. The 25 seconds faster re-convergence was reached after a complete GNSS signal outage in a deep urban canyon scenario.

An IoT Platform for Occupancy Prediction using a Hybrid Ada-SVM Algorithm

Alec Parisé

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Abstract

The Internet of Things is a network of devices able to connect, interact and exchange data without human intervention. Emerging sensing technologies are allowing for advancing IoT by enhancing indoor experiences by immersive understandings of our indoor environment. Innovative approaches ranging from context aware sensing platforms to dynamic robot sensing can be seen in the IoT community but how do reactive sensors provide enough data to tell occupants about their environment and how do we reciprocate with the environment? Most of today's research focuses on collecting indoor environmental data with the purpose of reducing costs of operation facilities management, and what this research proposal aims at is a non-intrusive method for predicting occupancy for reducing building emission while also promoting a comfortable and productive working or living environment. To further elaborate on the contributions of this research proposal, an IoT platform utilizing an open source architecture consisting of Arduino and Raspberry Pi 3 B+ will be deployed. By utilizing temperature, humidity and pressure sensors for observing ambient environmental characteristics while combining PIR motion sensors, C02, and sound detectors a concise occupancy detection model can be created, and by applying a hybrid algorithm composing AdaBoost and SVM, occupancy prediction will be facilitated. This platform is a low-cost and highly scalable both in terms of the variety of on board sensors and portability of the sensor nodes, which makes it well suited for multiple applications related to occupancy and environmental monitoring.

Synergizing Batch and Stream Analytics for IoT Data

Hung Cao

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Abstract

Exploring new insights from IoT data streams means not only creating useful intelligence and higher-level information in a timely way before they become outdated, but also generating long term predictions and decisions from historical IoT data. This paper aims to explore the synergy of different data rates, message passing, and processing algorithms to support batch and stream analytics and visualization. Towards this end, we present a cloud architecture containing seven main engines that deal with IoT data management, stream processing, stream analytics, batch processing, batch analytics, data visualization, and data storage. For validation purposes, a smart parking scenario is used to evaluate the architecture, and two analytical workflows are implemented to demonstrate a web application for predicting parking spot availability.

An Evaluation of Model Data for Computing Sound Velocity Profiles in Shallow Arctic Waters

Khaleel Arfeen

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Abstract

Melting sea ice has led to an increase in navigation in Canadian Arctic waters. However, these waters are sparsely surveyed and pose a risk to mariners. Recognizing this issue, the government of Canada has granted funds to develop a pilot program to begin collecting bathymetric data through a crowd-sourced approach. As part of this project, the University of New Brunswick's Ocean Mapping Group is tasked with the processing of the collected data. Through an automated approach the software will process the data with the end product being a final depth measurement. The software has been broken down into several modules to complete the task at hand. This report will delve on the sound velocity profile (SVP) module, including the methodology and results. Specifically, an investigation will be completed on comparing the differences from obtaining the sound velocity measurements from observed data vs. model data and the associated errors observed.

Noise Characteristics of GNSS Coordinates in a Volcanic Region

Gozde Akay

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Abstract

The aim of this study is to estimate the noise characteristics in GNSS time series of permanent stations on the Soufrière Hills Volcano, Montserrat. Ground deformation measurements using geodetic space techniques can be very useful to monitor volcanic activity in order to assess the hazard situation. However, it is recognized that if noise parameters present in the data are not estimated, they will cause a bias in any subsequent deformation analysis. The GNSS-derived time series consists of a deterministic and stochastic part which can be characterized by estimation of trend, periodic variations and random noise. In this study, outliers were detected using the interquartile range method and the offsets were estimated with an automated algorithm before analyzing periodic signals and random noise. While analyzing seasonal periods, amplitudes of annual tropical and draconitic oscillations with their harmonics were calculated. Maximum Likelihood Estimation is the chosen method for be used for detecting the type and amount of random noise as it does not need the time series in regular intervals which is very advantageous for analyzing data affected greatly by interruptions caused by eruptions such as in volcanic regions. First, random noise analysis results were compared between the model that taken into consideration periodic variations and commonly used one that only estimated annual and semi-annual variations. Then, several noise models were tested to assess random noise characteristics of the network.

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