



SCHULICH
School of Engineering

DEPARTMENT OF
GEOMATICS
ENGINEERING

DEPARTMENT OF GEOMATICS ENGINEERING

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Dear Reader

We are very excited about a new opportunity for our students. We have joined the Esri Canada Centres of Excellence (ECCE), a nationwide program established to reward universities with identified excellence in GIS. Members can nominate their most exceptional students to represent their school as Student Associates in the ECCE program. Student Associates gain access to technical expertise, resources, and software provided by Esri Canada, as well as free admission to Esri Canada user conferences. Each member can also nominate students to participate in an annual App Challenge, a one-week coding competition that seeks to promote innovation and creativity using GIS technologies at each Centre. Thanks to Dr Xin Wang who volunteered to be our ECCE Coordinator..

As usual, both of our advisory group meetings were convened in the winter semester. The annual Geomatics Engineering Liaison Committee (GELC) meeting took place on 18 January and was followed by the Geo Expo on the 19th. Congratulations to Geomatics Exposition Commissioner Madison Shevchuk

and her Geomatics Engineering Student Society (GESS) team for a well-organized and executed event.

The Geomatics Engineering Advisory Committee (GEAC) meeting took place on 9 March. New members joining in 2017 were Brent Hall, ESRI Canada, Kris Morin, Northwest Geomatics and Mark Hatcher, Natural Resources Canada. We had a very productive meeting that, following a report on the state-of-the-department, addressed a number of key strategic issues including professional accreditations, programming languages, geomatics days and our internal curriculum review process. The GEAC meeting was followed by another fantastic awards night to celebrate the academic excellence of our undergraduate and graduate students.

Other matters of interest:

- Dr. Michael Barry was unanimously re-elected to continue as the University of Calgary's representative on the Canadian Board of Examiners for Professional Surveyors (CBEPS).

- Dr. Mozhdeh Shahbazi led successful equipment grant application from the University of Calgary Engineering purchase new imaging equipment to be used in several undergraduate courses: a Parrot Sequoia is a multi-spectral camera; a FLIR Vue Pro thermal camera; and a Canon EOS MS camera.

- Both Dr. Barry and I presented at the 2017 Alberta Land Surveyors' Association (ALSA) AGM in April in Jasper. I gave a brief overview of recent developments in the Department that was followed by Dr. Barry's report on the Chair in Land Tenure and Cadastral Systems.

Finally, it is with great sadness that we learned of the passing of Alex Hittel, who was instrumental in the establishment of the Division of Surveying Engineering. An article about Alex's accomplishments written by Dr Gérard Lachapelle can be found on page 2 and 3.

Derek Lichti
Professor and Head



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In Memoriam



Photo of Alex Hittel from Alberta Land Surveyors' Association : President of ALSA 1998/1999

Dr. Alexander (Alex) Hittel, 1931-2017

The passing of Alex Hittel on May 17, 2017, in Calgary is an immense loss to the geomatics community. Alex was a pioneer and visionary who made major contributions to the modernization of the profession through the introduction of satellite positioning and inertial surveying, in addition to having played an important role in the creation of the Department of Geomatics Engineering at the University of Calgary in

the late 1970s.

Alex was born in Fox Valley, Saskatchewan. His birth certificate records his birth on Section 13, Township 19, Range 26, West of 3 (near Fox Valley, Saskatchewan, Canada), a description that augured well for a future land surveyor. Following high school, Alex worked for a few years in the federal government's Prairie Farm Rehabilitation Administration (PFRA). During that time, he enrolled in the surveying and drafting

program at the Provincial Institute of Technology and Art (now SAIT Polytechnic), Calgary, graduating in 1953. He then joined Shell Canada Limited where he held numerous positions over a period of 30 years, including head of the Sheltech Canada Division during the latter years.

Alex was self-taught. Through sheer motivation and persistence, he successfully studied while fully employed to become ALS (1965) and DLS (1972). (1981). Alex was granted his P.Eng. in 1981 by APEGA under the Senior and Distinguished Category for his Leadership in building advanced geomatics engineering products and systems. His lifetime involvement in, and promotion of, the profession is well-known. He served the Alberta Land Surveyors' Association (ALSA) in numerous capacities, including its presidency in 1977-78 and 1998-99. He was involved for many years in the Canadian Petroleum Association (CPA) Surveys and Mapping Committee, in addition to national advisory committees and task forces on surveying and geodesy. He received awards from both the ALSA and CPA for his dedication and contributions. One success led to another...

In the early 1970s, Alex saw the potential of the

Navy Navigation Satellite System (Transit/Doppler) for geodetic surveying in the petroleum industry. He convinced U.S.-based JMR Instruments to establish an office in Calgary to develop and sell receivers. The success was immediate and Alex started to build up a team of young survey engineers, many from the University of New Brunswick (UNB) and Laval University to use the new technology in major projects. His next step was to introduce inertial survey systems to petroleum exploration through the acquisition of several Ferranti systems in the mid to late 70s. Sheltech started to successfully conduct large inertial survey projects for Shell International and other exploration companies around the world. Encouraged by this continued success, Alex decided to initiate research into GPS in 1979, and the first Stanford Telecom receiver was delivered to the company one year later. This was followed by the acquisition of several TI4100 units in 1982; these were deployed worldwide for countless land and sea-borne positioning and navigation projects for several years. The Sheltech team of engineers continued to grow in the process. In 1983, Sheltech was sold to Nortech Surveys and the team followed. At the insistence of Alex, the Norstar Instruments division was created to develop GPS equipment; this resulted in an advanced receiver, the

Norstar 1000, in 1987. In view of unforeseen delays of GPS satellite launches by the U.S. DoD to achieve worldwide coverage, markets remained limited and Nortech was obliged to sell the division to NovAtel Inc., who re-engineered the equipment and successfully developed a series of advanced and highly successful GPS/GNSS products that remain among the most advanced in the world. One success led to another...

During the 1970s, as Alex's pioneering and successful contributions to the early use of Doppler surveying became widely recognized, he was invited to serve on the University of New Brunswick (UNB) Advisory Committee on the Surveying Engineering Program. UNB was an academic leader in satellite positioning research, thanks to Dr. Dave Wells and Calgary-born Professor Edward Krakiwsky, who had joined the department after doctoral studies at The Ohio State University. In the preceding years, Alex and his ALSA colleagues had been holding discussions regularly with the Alberta Government to establish an academic survey program in Alberta. After much discussions and advocacy, Alberta universities were invited to submit proposals. The surveying engineering program proposed by the University of Calgary received

funding and began in 1979 with Professor Krakiwsky as first Head. The program was renamed Geomatics Engineering in 1992 and is now one of the most successful ones in education and research worldwide. The synergy between the department and the Alberta geomatics and land surveying professions has resulted in one of the world's most advanced industries.

In 1989, at an age when most people retire, Alex successfully started a second career at Calgary-based All Can Engineering Surveys, where he held numerous positions until his retirement one week prior to his death.

Alex's major recreational activities were his grandchildren and great-grandchildren, in addition to golf, a game he played with passion until the day he passed away. Alec is survived by his wife Jean, sons Douglas, James and Jeff, daughter Jennifer; grandchildren Alexander, Matthew, Sarah and Karla; and great-grandchildren Henry and Jacob.

Alex's professional accomplishments are not easily summarized; defining traits include vision, persistence, sustained hard work and dedication. Alex planted many seeds and most came to successful germination and maturity. His legacy on the geomatics profession will

be felt for decades.

I met Alex for the first time in 1977 while working at the Geodetic Survey of Canada. Alex wanted advice on physical geodesy and geodetic reference systems for the worldwide survey-related activities of Shell Canada Limited. I was immediately impressed by his enthusiasm, vision and can-do attitude.

In 1980, I joined Sheltech Canada where I started research work on GPS. The eight years I worked with Alex at Sheltech

Canada and Nortech Surveys were filled with learning, hard work, fantastic experience and rewards. These allowed me to have 30 wonderful and fulfilling years as professor of geomatics engineering at the University of Calgary after joining the latter in 1988. Numerous former colleagues who worked with Alex feel the same.

Thank you, Alex!

G rard Lachapelle
Professor Emeritus



AWARDS & HONORS

- Rakesh Kumar PhD candidate was awarded Alberta Graduate Citizenship Award. This award is granted to 50 people across the province of Alberta. Out of 20 University of Calgary students, Rakesh was ranked number 7.
- Dr. Michael Sideris awarded Best Professor Award from the Geomatics Students at the First and Second Year dinner. Dr. Sideris teaches the ENGO 327—Spectral Analysis in Geomatics course in the Winter term of the second year.
- Dr. Michael Barry awarded the Graduate Award from the Geomatics students from the 2016/2017 Geomatics graduating class at the 3rd and 4th year dinner. Dr. Barry teaches many different courses for the Geomatics Undergraduate program.
- Dr. Steve Liang is working on Air quality crowdsourcing using Internet of Things. Dr. Steve Liang is working to utilize a web of sensors around Calgary to create a more accurate map of the cities' air quality and to have intercommunication between devices to help Calgary move towards being a collaborative smart city. The article was featured in the Metro News: <http://www.metronews.ca/news/calgary/2016/09/27/calgary-sensor-pilot-helps-you-plan-a-run-best-air-quality.html>
- Dr. Naser El-Sheimy elected to the Institute of Navigation 2017 Fellow Membership. The Institute of Navigation (ION) announced that Dr. Naser El-Sheimy is a recipient of the 2017 Fellow membership during the ION International Technical Meeting and Precise Time and Time Interval Systems and Applications meeting in Monterey California. Dr. El-Sheimy was recognized for major contributions to the development, dissemination and commercialization of integrated navigation system technology and for significant education impact on the next generation of Navigation professionals.



Geomatics Events

Geomatics Exposition

We are fortunate to have our Geomatics Engineering Student Society put on another successful Geomatics Exposition. This event was held January 19, 2017 and this year we hosted 19 companies. Many of them had previous graduates from our Bachelors, Masters and PhD programs; we were glad to see all of you! It definitely helps to have real live examples of success come back and talk with the students about industry.

It was well attended by Geomatics students and 1st year engineering students.



Photo by Courtenay Canivet



Photo by Courtenay Canivet



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Photo by Courtenay Canivet



Photo by Courtenay Canivet

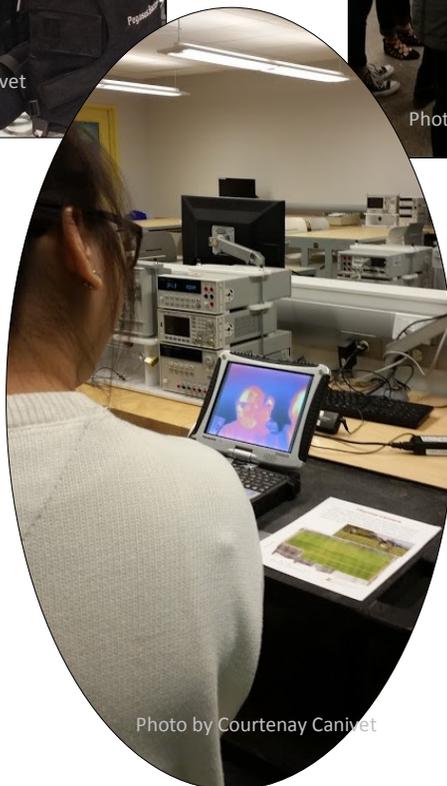


Photo by Courtenay Canivet

Women in Engineering Day

Dr. Mozhdeh Shahbazi, one of our new Faculty members, spearheaded Women in Engineering Day for our Department. This year's demos came from all the different areas of Geomatics to help showcase the vast diversity of our field to potential future students.

Geomatics Events & Outreach

Award Night

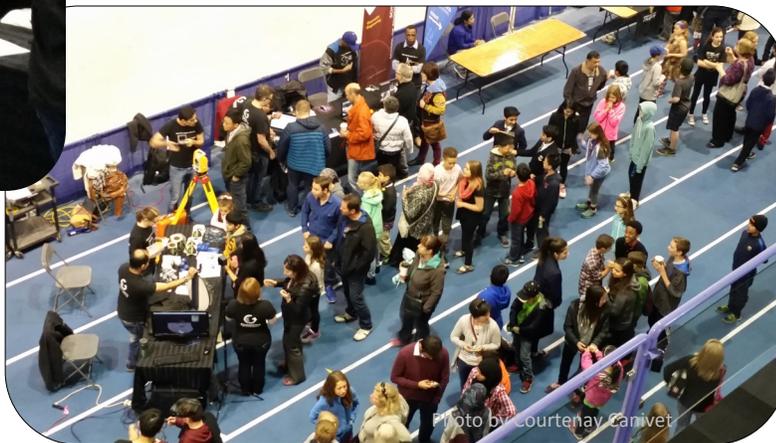
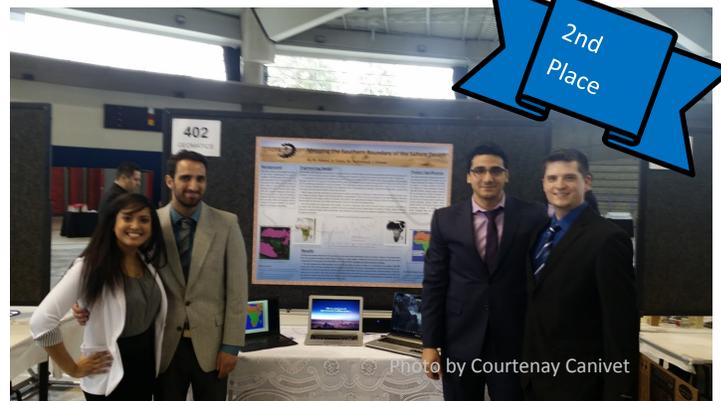
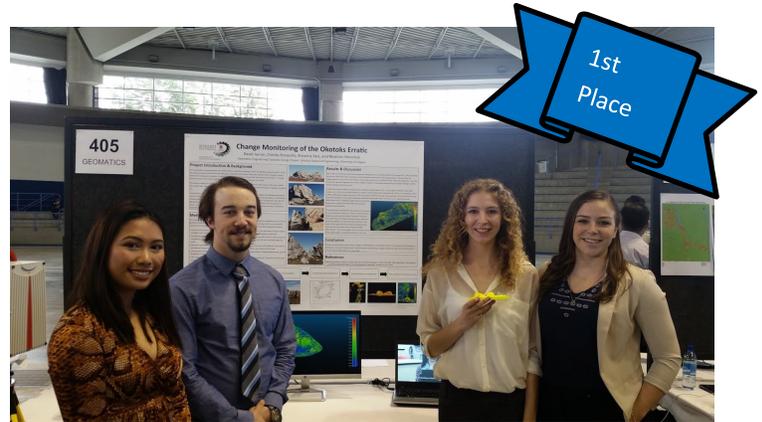
In March, it was again time to celebrate all the hard work from both the Graduate and Undergraduate students in the Geomatics Department. The annual Geomatics Award night took place on March 9, 2017 in Cassio A&B. Thank you to our donors for their generosity and all the industry support for our students and program.



Capstone Design Fair

Schulich School of Engineering Capstone Design Fair took place on DATE. Well done to all the groups for all the hard work and congratulations to the 1st and 2nd place Geomatics teams. 1st place was awarded to the project called 'Change Monitoring of the Big Rock' and the team members were David Jarron, Cheska Ronquillo, Breanna Sass and Madison Shevchuk, supervised by Dr. Derek Lichti.

The 2nd place Geomatics team's project was titled 'Mapping the Southern Boundary of the Sahara Desert'. The team members were Mohamad Hammoud, Joann Simoes, Mostafa Abbasi and Keanan Cross, supervised by Dr. Michael Collins.



Calgary Youth Science Fair

The Calgary Youth Science Fair was held at the Olympic Oval April 19—22nd and each day was filled with tons of fun and learning. Our department had an interactive booth for parents and students to come by, experience Virtual Reality, learn about traditional survey equipment, learn about what Geomatics is and most of all have fun!

Faculty Spotlight



Personalized Route Recommendation based on Big PGS Trajectories

By Xin Wang

Route recommendation is widely used in human's daily life, and many map service companies provide route recommendation to users, such as Google Maps. However, the current route recommendation services are unsatisfactory and can be further improved due to the following issues: first, most map services company provide users the shortest distance or least time path. However, previous studies show that less than 40% of these routes are chosen by users in reality. Second, the current route recommendations are not personalized, which means that the same route will be recommended to all users no matter who you are. Nonetheless, route recommendation should be personalized because users have different travel route preferences which are affected by many travel factors such as distance, time, fuel consumption, safety and the traffic light number along the route. However, it is difficult to develop a personalized route recommendation by constructing a comprehensive metric of travel factors for each user, because making a survey for all users would

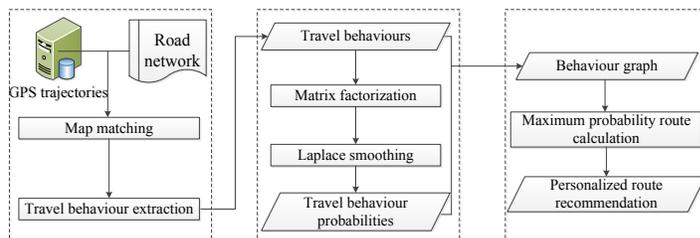
cost a large amount of time and money.

Besides, the effectiveness of such a survey might be not convincing, as people often do not clearly realize the different significances of the factors in their daily travel.

Fortunately, GPS trajectory provide an alternative way to make a personalized travel route recommendation. With the development of information technologies, a massive number of GPS trajectories are available for human movement study. A GPS trajectory is a sequence of time-stamped GPS points which are sampled from a spatial movement track. Hence, users' historical travel routes can be retrieved from their GPS trajectories, which is a vital clue to make personalized travel route recommendation.

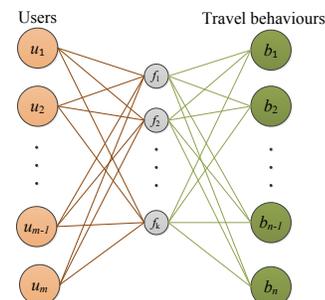
However, how to learn users' travel route preference from GPS trajectories is still a challenging problem. We noticed that user's route preference can be taken as a sequence of user's behaviours which record user's location and time information in the travel. Therefore, we defined travel behaviour as a combination of road segment and time and extracted users' travel behaviours from their historical GPS trajectory. Based on travel behaviours, we proposed a maximum probability route recommendation

(MaP2R) method to provide user a personalized route along which the probability of user's travel behaviours is maximum given an origin and destination.



One issue of MaP2R is that the travel behaviours of each user extracted from GPS trajectories are very limited, as most users travel on the routine routes every day, such as from home to work. To solve this problem, we adopted matrix factorization, a collaborative filtering method, to estimate users' preferences for the travel behaviours they have never conducted before. The principle underlying matrix factorization is that users and travel behaviours are both connected to a vector of hidden travel factors, and the higher correspondence between the user vector and the travel behaviour vector implies that the user has a larger preference for the travel behaviour. Another issue is that there are some road segments where all users have never travelled before. To avoid assign a zero probability to the travel behaviours on these road segments, Laplace smoothing method is applied to assign

a small probability to these travel behaviours so that

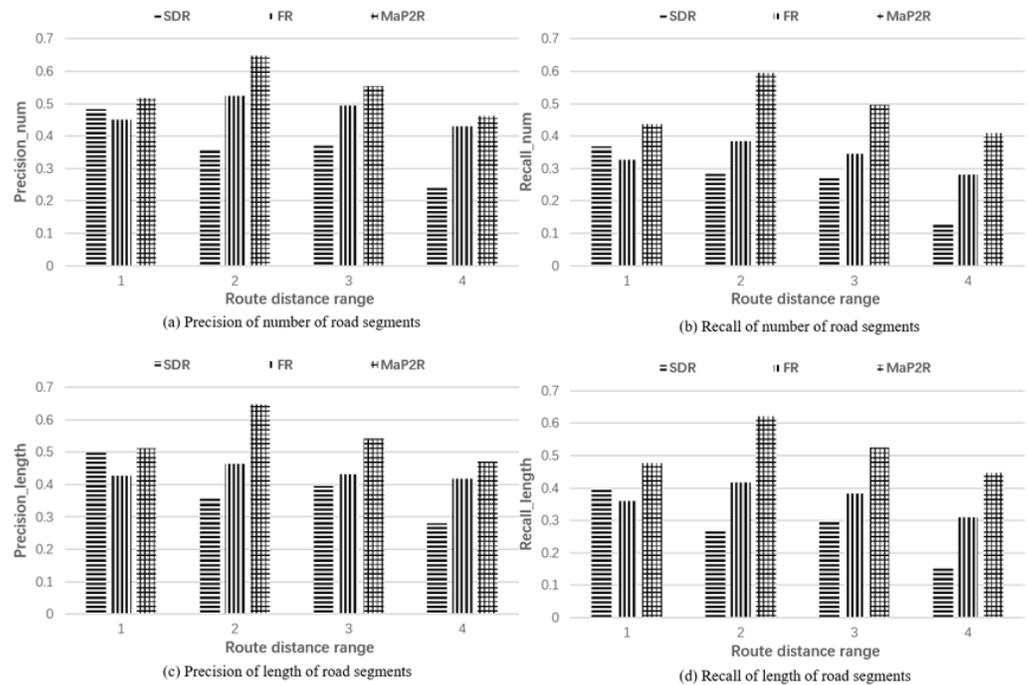


MaP2R can provide user a personalized recommendation given any origin and destination in the road network. Experiments are conducted on a real GPS trajectory dataset in Beijing, China. The dataset is divided into four groups based on the length of GPS trajectories, i.e. Group 1: (2.05-14.58km), Group 2: (14.58-19.21km), Group 3: (19.21 - 28.74km) and Group 4: (28.74-56.72km). The performances of the proposed MaP2R and two baseline methods (shortest distance

Faculty Spotlight

the baseline methods in both precision and recall in all four groups. When the trip is short, i.e. for trips in Group 1, the performances of the three methods do not have much discrepancy. SDR method is slightly better than FR method because when the distance between the origin and the destination is small, users prefer to the shortest distance path rather than passing through the high frequency road segments to reach the destination, which is reasonable in reality. With the increase of the distance of trips, MaP2R and FR outperform SDR because MaP2R and FR both consider users' preference from historical trajectories while SDR does not consider the factor.

We also compare the route recommendations from the proposed MaP2R with the two most popular online route recommendation applications, i.e., Google Map and Baidu Map. The figure below shows a real case of different route recommendation results that a user intends to travel from the origin location Sigma mall on the Zhichun road to the destination a research institution around 10am. The recommended route provided by MaP2R is to take 5th ring road to get to the destination while Google Map and Baidu Map recommends user travel on the 4th ring road and the 3rd ring road, respectively. The route recommended by MaP2R is same as the user's real travel



route but the routes recommended by Google Map and Baidu Map have a large discrepancy with the real route. The reason is that Google Map and Baidu Map would recommend all users the same route in the figure from Sigma mall to the research institution based on certain criterion, but MaP2R would learn users' preference from historical trajectories and recommend the route high corresponding with users' preferences. In fact, the target user is found indeed prefer to travel on 5th ring road by scrutinizing this users' historical GPS trajectories manually.

Personalized route recommendation is still an interesting research topic and has a large potential

application in industry. We are pursuing a further modification for MaP2R in the following aspects: 1) the spatiotemporal correlations between travel behaviours

and integrate with the current estimation model; 2) integrating explicit travel factors into the current model; 3) designing a distributed computing architecture for MaP2R.

