

# Message from the Head

Dear Valued Reader

Happy New Year! I hope that you had a chance to relax and rejuvenate during the holiday break. Also, I wish you all the best for 2012. Last fall, we welcomed the incoming second year students to their first course in the department (ENGO 333 – Computing for Geomatics Engineering) and in the winter semester they will have a chance to know more about Geomatics. Therefore, I would like to take this opportunity to welcome the students and wish them all the best in the department. We will do our best to provide you with a world-class geomatics education.

In an effort to promote Geomatics Engineering to first year engineering students, Tecterra sponsored

a “Lunch with Google” event on November 16<sup>th</sup>. Ed Parsons, Google’s Geospatial Technologist, made an excellent presentation that was attended by more than 150 participants including close to 80 first year engineering students. More details about his talk are provided in a later section of this newsletter.

The department Career Day is scheduled to take place on February 2<sup>nd</sup>. This event is a good opportunity for our undergraduate students to meet companies and secure summer and/or permanent employment. Similar to previous years, this event will be also announced to first year engineering students. We are expecting to have more than 25

companies at this event. On behalf of the department, I would like to thank the Geomatics Engineering Student Society (GESS) and Career Day Commissioners for their hard work and dedication in preparing for this event. This winter, we will be hosting the annual meetings of the Geomatics Engineering Liaison Committee (GELC) and the Geomatics Engineering Advisory Committee (GEAC) on February 1<sup>st</sup> and March 15<sup>th</sup>, respectively. An update regarding those meetings will be provided in the Winter Newsletter.

Dr. Ayman Habib  
Professor and Head

## Ed Parsons’ (Google’s Geospatial Technologist) Presentation



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There were more than 150 attendees at the presentation, including close to 80 first year students. Ed gave an outstanding presentation and kept the audience interest for the entire 90 minutes.

Thank you to Tecterra for organizing this event. Also, thanks to Marcia, Courtenay, Melissa, and Kirk for taking care of so many details before and during the event. Last but not least, thank you to the Geomatics Engineering Students Society (GESS) members as well as graduate student volunteers who showcased the Geomatics Spirit to all the audience.

# Congratulations

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- Congratulations to students who completed their graduate studies: Elmas Sinem Ince, MSc; Ana Kersting, PhD; Ting On Chan, MSc; Yasser Maghsoudi Mehrani, PhD.

- University of Calgary president Elizabeth Cannon was one of nine foreign associates inducted into the 2011 class of the National Academy of Engineering (NAE) in October, 2011 in Washington, DC. Election to the NAE is among the highest international professional distinctions accorded to an engineer.

Dr. Cannon's contributions to the field of geomatics spans a 25-year research career and her initiatives undertaken as a professor continue to thrive and shape the direction of the field. She was elected to the United States National Academy of Engineering "for innovative use of GPS data for a wide range of applications and for pioneering the field of geomatics."

- Dr. Ayman Habib is this year's recipient of the Teaching Excellence Award for third and fourth year courses in Geomatics Engineering. The award was presented by the University of Calgary Engineering Students Society at their annual Third and Fourth Year Dinner, held on November 23, 2011.

- Congratulations to the following graduate students who won highly competitive Student Sponsorship Awards from the U.S. Institute of Navigation to present their papers at the GNSS 2011 International Conference held in Portland,

OR, during September 20-23, 2011: Shuang Du (Supervised by Professor Yang Gao): *An Inertial Aided Cycle Slip Detection and Identification Method for Integrated PPP GPS/MEMS IMU Systems*. Nima Sadrieh (Supervised by Professor Gérard Lachapelle): *Spatial Antenna Diversity Performance for Indoor GNSS Applications*, and Xing Zhao (Supervised by Professor Naser El Sheimy): *Multi-Sensors Observability Analysis on Pedestrian Navigation System*.

- Congratulations to the following doctoral students who received their degree at Fall Convocation. Their thesis topics are shown in brackets; their theses are available on the ENGO website ([www.geomatics.ucalgary.ca/graduatetheses](http://www.geomatics.ucalgary.ca/graduatetheses)) Haris Afzal, supervised by Professor G. Lachapelle (Use of Earth's Magnetic Field for Pedestrian Navigation) Pratibha Anantharamu, supervised by Professor G. Lachapelle (Space-Time Equalization Techniques for New GNSS Signals) Yong Bian, supervised by Professor B. Mercer (Polarimetric and Interferometric SAR Statistical Analysis and Signal Processing) Hassan Elhifnawy Eid, supervised by Professor N. El-Sheimy (Automated Urban Features Classification and Recognition from Combined RGB/Lidar Data) Ahmed Kamel, supervised by Professor G. Lachapelle (Context Aware High Dynamics GNSS-INS for Interference Mitigation) Shashank Satyanarayana, supervised by Professor G. Lachapelle (GNSS Signal Characterization and Enhanced Weak Signal Processing) and Wesley Teskey, supervised by Professor N.

El-Sheimy (Assessment and Attenuation of Movement Disorder Motion using Inertial Sensors).

Nine MSc and two MEng students also received their degrees at this convocation

- Dr. Naser El-Sheimy is the 2011 recipient of the prestigious ASTech (Alberta Science and Technology) Award for Outstanding Leadership in Alberta Technology. The ASTech Awards are the premiere acknowledgement of scientific and technological achievement in Alberta. The Outstanding Leadership in Alberta Technology award is presented to an individual or team of individuals who have played a leadership role in, and made a contribution to, a technological innovation or breakthrough in Alberta. The award was presented to Naser at a gala function on Friday, October 28, here in Calgary.

Naser's recognition through this award is just one of his many achievements in geomatics. The Department is proud to have him on our team.

# Research News

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- Patent No. US 7,952,519 B1 on Methods and System for Detecting GNSS Spoofing Signals has been issued by the U.S. Bureau of Patents and Trademark Office to inventors Dr. Ali Broumandan, Professor Gérard Lachapelle and Professor John Nielsen. The Method operates on signals originating from inauthentic (spoofing) sources. A synthetic array using a receiver antenna that is randomly spatially translated is used to gather

alleged GNSS signals that are then processed to determine the spatial correlation between them, a high spatial correlation between the signals indicating a probable inauthentic source for the GNSS signals. The development of such anti-spoofing technologies is important as emerging spoofing methods constitute an increasing threat to the use of GNSS in consumer devices and GNSS receivers.

Dr. Broumandan is a post-doctoral fellow in the PLAN Group and Professor Nielsen is a faculty member in the Department of Electrical and Computer Engineering.

# Research Spotlight

## Vision-based Pedestrian Indoor Navigation

Article by Yang Gao, Bei Huang and Shuang Du  
(Positioning, Navigation and Wireless Location)



Figure 1. A consumer-grade MEMS IMU by Xsens and a low-cost webcam by Logitech

Pedestrian indoor navigation still remains a challenging task. The traditional solutions try to integrate inertial measurement units (IMU) with high-sensitivity GPS to overcome the GPS signal outages and calibrate the IMU biases and drifts. Current mobile devices that integrate low-cost IMU and GPS sensor chips such as smart phones however can hardly satisfy the desired performance. Researchers are exploring other sensors such as cameras available in the mobile units for improved performance. Vision-based navigation is actually not a new topic in the field of photogrammetry. Mobile mapping systems have already employed stereo

cameras to extract landmark location from stereovision images. But current smartphones and tablets, potential to support pedestrian applications, have only one camera so that it can only provide 2D monocular images. Inspired by techniques used in the aerial photogrammetry, an investigation has been conducted by the Positioning & Mobile Information Systems Group (PMIS) to integrate a consumer-grade MEMS IMU with one ground-looking camera as shown in Figure 1 to provide indoor navigation solutions by continuously tracking the static ground features. The ground features are extracted and matched with the sequential images but only those well-separated feature correspondences are selected, as shown in Figure 2.

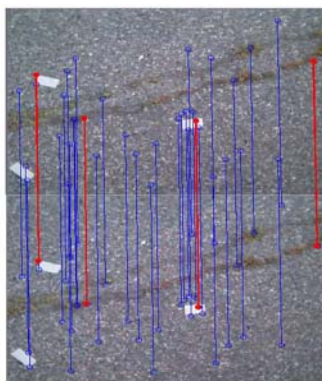


Figure 2. Feature detection and matching (blue) between two sequential images. Four feature correspondences (red) are selected because of good geometry.

The system solution includes three main steps: feature detection, feature prediction and error calibration. First the features detected by the camera are compared with those predicted by the IMU sensor, and their residuals are then used to calibrate the error states including the IMU bias and drift. In order to evaluate the performance of the proposed vision-based navigation approach, a field test was conducted in an open sky scenario which allows the determination of a reference solution using the differential GPS (DGPS) technique.

Figure 3 shows the comparison between the reference trajectory from DGPS and the derived trajectory from the vision-based system. Although the resultant positioning accuracy is better than 5 meters, the trajectory appears to be rather poor with respect to DGPS. Since the camera height determines the image scale, we have found the trajectory is quite sensitive to the camera height. As the height information of the IMU can be derived from a local terrain model if it is available, it can be applied as a constraint. The height constraint has improved the navigation solution as shown in Figure 4 where the test results indicate that the derived trajectory agree quite well with the reference solution despite of some mismatched feature correspondences. The trajectory from the vision-based system become much smoother and the positioning accuracy is improved to be better than 3 meters. This is promising to support pedestrian indoor navigation.

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## Alumni Voice

I started studying Geomatics engineering at the university in my home town Stuttgart, Germany. An exchange program for students of Civil and Geomatics engineering has been in place for over thirty years between the University of Stuttgart and University of Calgary. I had the amazing opportunity to participate in this program and come to Calgary for 8 months. Canada was such a great experience for me that I decided to come back just 1 year later, in 2006, directly after graduating.

I took my first job with ORTHOSHOP Geomatics Ltd., a company that offers photogrammetric services. When I joined

the team, ownership had just changed which opened up great opportunities. I started out by managing projects and then moved on to leading the production team. The position at ORTHOSHOP allowed me to directly apply various concepts of Geomatics engineering (Photogrammetry, GIS, GPS/IMU Integration). I could advanced my technical knowledge and in addition, build up leadership skills. After 5 years, I decided to switch to TransCanada where I currently work in the asset management group and coordinate large-scale GIS projects.

Throughout these first years of my career, I found that it has been the engineering

education that has allowed me to embrace challenges, dare to apply new approaches and be proud of successes.



Katrin Franke, MSc 2006



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Although the test is based on the integration of accelerometer, gyroscope and camera, the system can be easily integrated with additional sensors to achieve further performance improvement. For instance most mobile units are now integrated with magnetic compass which can output attitude measurements to improve both attitude and positioning accuracy. The Wi-Fi based short-range positioning technique will also be very useful in the indoor environments to provide position calibration for the IMU/Camera system. Further, with Internet connection through Wi-Fi, the images from the camera can be compared with the online database of geo-tagged photos. The above research work is currently in progress within the PMIS group.

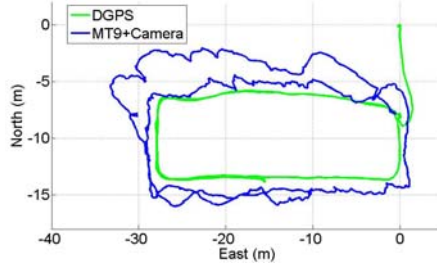


Figure 3. Comparison of DGPS reference and derived trajectory without height constraint

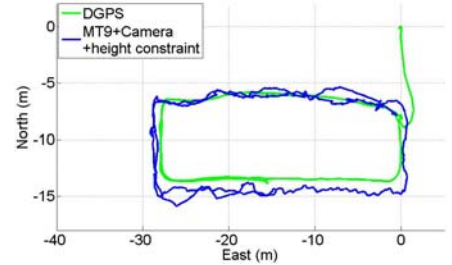


Figure 4. Comparison of DGPS reference and derived trajectory with height constraint

## Department Activities

Thank you to all of you who came to the Geomatics Christmas party December 13th. The party was a great success. Thank you so much for all your wonderful, tasty food contributions!

We had a lot of fun deciding on the winners for the food contest. They were:

- First Place—Mohannad Al-Durgham
- Second Place—Marcia Rempel
- Third Place—Erwan Renaudin



## Coming Events

- Geomatics Engineering Liaison Committee (GELC) - Wednesday, February 01, 2012
- Geomatics Career Day - Thursday, February 2, 2012. Contact Career Day Commissioners Natasha Wong Ken and Shana Davis at [geomaticscareerday2012@gmail.com](mailto:geomaticscareerday2012@gmail.com)
- Geomatics Awards Night - Wednesday, March 14, 2012 5:30 - 8:00 pm in MacEwan Student Centre Cassio A & B
- Geomatics Engineering Advisory Committee (GEAC) Meeting - Thursday, March 15, 2012—8:30am

### Sites to Visit:

- <http://gess.geomatics.ucalgary.ca/>
- <http://www.edparsons.com/>
- <http://schulich.ucalgary.ca/civil/exchange/outgoing/stuttgartSW>
- <http://people.ucalgary.ca/~point/>