



# Message from the Head

Dear Valued Reader

Over the Winter Semester, the department has been busy with several events. The Department's 16<sup>th</sup> Annual Career Day took place on February 2<sup>nd</sup>. We had more than twenty-five national and international companies participating in this event. On behalf of the Department, I would like to thank the Geomatics Engineering Student Society (GESS) and the Career Day Student Committee for all their efforts in organizing this year's Career Day. We also hosted our annual meetings of the Geomatics Engineering Liaison Committee (GELC) and the Geomatics Engineering Advisory Committee (GEAC). These meetings gave us the opportunity to meet with the Department's external supporters and solicit valuable

feedback to ensure first-class service to our undergraduate and graduate students. The Department's Annual Awards Night took place on March 14<sup>th</sup>. On behalf of the Department, I would like to congratulate all the award winners and wish them continued success throughout their academic and professional careers.

I would like to congratulate the Geomatics second year students for finishing the first full semester in Geomatics Engineering. I hope that they had a chance to know more about Geomatics and we are looking forward to providing more information throughout the third year. To our fourth year students: well done on finishing your studies. It has been a pleasure having you in the Geomatics family for the last few years and we wish you all the best in your future endeavors as Geomatics

Engineers. We hope that you will maintain a long-term relationship with the Department. Your feedback regarding your experience in the department and how it relates to your work will be essential to the success of our efforts in delivering graduates ready for any challenges they might face.

The Schulich School of Engineering will be hosting a Block Party on May 24<sup>th</sup> at 5:00 p.m. to unveil the plans for the new SSE building and celebrate our growth, which includes enhancing teaching and learning space with new research labs, student homerooms and lecture theatres. Please, mark your calendars and register for this event through (<http://Schulich.ucalgary.ca/blockparty/>).

Dr. Ayman Habib  
Professor and Head

## Geomatics Engineering Advisory Committee 2012



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L to R:

Guy Gendron, Corinna Vester, Rita Cheng, Grant Chevallier, Landra Trevis, Kevin Magowan, Victoria Hoyle, Mark Petovello, Tim Crago, David Parker, Irwin Natt, Ayman Habib, Kyle O'Keefe.

# Congratulations

- Congratulations to students who completed their graduate studies: Siddharth Siddharth, MSc; Andres Ortiz, MSc.



*Congratulations to our Graduate Awards winners. Event was held on Wed, March 14.*

- Four awards were presented to Geomatics Engineering professors at the Schulich School of Engineering Faculty and Staff Awards Ceremony on February 27. The Geomatics Engineering Teaching Award of Excellence was presented to Dr. Mark Petovello. This is the second time Dr. Petovello has won this award, given in recognition of his consistently excellent teaching of undergraduate, graduate, and professional courses. Dr. Naser El-Sheimy is this year's recipient of the Geomatics Engineering Graduate Educator Award. He is supervising 21 students (17 as a supervisor and 4 as a co-supervisor). He had 8 graduated students over the last two years, including 6 PhD students. Dr. Kyle O'Keefe won the Geomatics Engineering

Research Excellence Award. This award is presented every two years and recognizes Dr. O'Keefe's research successes in 2009-2011 that include several national and international awards. The Schulich School of Engineering Mentoring Excellence Award was presented to Dr. Gérard Lachapelle in recognition of years of support he has provided to his many colleagues and former students who have pursued successful academic careers in Calgary and around the world.

- The Geomatics Engineering Students' Society is pleased to announce that Geomatics won ENGG Week 2012. This year the department chose the nostalgic theme of "Geo Presents the '90s," where geo participated in a week of '90s pop culture with hilarious pun names of famous '90s artists such as "Backsight Boys". We hope our spirit carries on for 2013 (if 2013 ever comes), and we wish geo the best of luck in the future!



- Dr. Kyle O'Keefe was named this year's Geomatics Engineering Professor of the Year at the 2012 Schulich School of Engineering Graduation Banquet. Kyle was selected for this honour by the members of the 2012 graduating class. In presenting the award, the class noted his enthusiasm for Geomatics Engineering, personal commitment to undergraduate student success, approachability, and his willingness to teach ENGO 585 - Wireless Location in 2012.

- Congratulations to the following Geomatics graduate students who won Awards at the ASPRS Annual Conference March 19-23, 2012 in Sacramento California.

*Ivan Detchev* (Supervised by Professor Dr. Habib) was the 2012 recipient of the Robert E. Altenhofen Memorial Scholarship.

*Jacky Chow* (Supervised by Professor Dr. Teskey and Dr. Lichti) was the 2012 recipient of the Z/I Imaging Scholarship.

*Ana Kersting* (Supervised by Dr. Habib) was the 2012 recipient of the Francis H. Moffitt Memorial Scholarship.

- Dr. Kyle O'Keefe and Dr. Mark Petovello each received teaching awards at the Schulich School of Engineering's First and Second Year Dinner. The award winners are selected by students in first and second year engineering.

# Research News

- Dr. Klaus-Peter Schwarz, a world-renown inertial geodesist and Professor emeritus, Geomatics Engineering, University of Calgary, passed away in Calgary at 3:30 am on Friday, January 20, 2012 at age 73. Klaus-Peter Schwarz joined the faculty of Engineering in January of 1980, into the newly-formed Division of Surveying Engineering, after completing degrees at universities in Germany, Canada, and Austria. He was a leading researcher world-wide in the area of inertial navigation and gravimetry, and Head of the Department of Geomatics Engineering from 1990 to 1995. He retired in 2001. Schwarz worked to establish the U of C as an international centre of excellence in geodesy. He contributed enormously to the research and high graduate educational

standards of the department and University. His former graduate students are now internationally recognized scientists throughout the world. He developed numerous new methods related to integrated navigation and airborne gravimetry, and served as president of the International Association of Geodesy from 1995 to 1999. He published more than two hundred major scientific publications in the area of geodesy and navigation. Schwarz was conferred the eminent and rarely given title "Doctor Engineer Honoris Causa" by the University of Hannover, Germany, on the occasion of its 175th anniversary celebrations in 2006. In addition, he received an honorary degree from Wuhan University, PR China in 1994, and was a Full Member of the Russian Academy of



Navigation and Motion Control, in addition to numerous international awards and recognitions. He was recognized as a Killam Fellow in 1986 by the University of Calgary. An

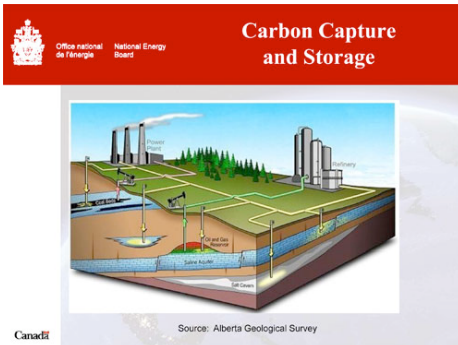
endowed graduate scholarship is being set up in Dr. Schwarz's name. To donate, click here:

<https://netcommunity.ucalgary.ca/KlausPeterSchwarz>

# Research Spotlight

## Monitoring Geological CO<sub>2</sub> Storage by Integrated Gravimetric and Geodetic Methods

Article by JW Kim (Earth Observation)



Carbon Capture and Storage (CCS), known to be the most tangible option of reducing greenhouse gas emission, is a greenhouse gas emissions reducing option that involves an integrated process of three steps: capture, compression/transportation, and storage (Figure: left). It is very important to us since, according to the 2009 International Energy Agency report, in terms of 2007 annual total CO<sub>2</sub> emissions, Canada was ranked as the No. 7 country in the world, accounting for 1.9% of the world's total CO<sub>2</sub> emission amount. Fortunately, the potential capacity of subsurface storage is known to be as much as 600 million ton/year, which is nearly 40% of Canada's projected emissions in 2050. In terms of securing the storage, the tracking of the injected CO<sub>2</sub> plume in the geological storage and the detection of any leaks through the caprock, aquifer, and to atmosphere are very important.

Although assessments of CO<sub>2</sub> storage are possible with a number of geophysical and geodetic techniques, gravity monitoring is especially effective for estimating subsurface mass change and movement despite its low resolution and non-unique solution. However, applications of the gravimetric method have been limited for monitoring geological CO<sub>2</sub>, mainly because conventional spring gravimeters suffer from relatively low sensitivity and the large nonlinear drift effects of the mechanical springs. These characteristics complicate the analysis of the non-periodic gravity signals that are vital for interpretation and analysis. In addition, the gravimeter records combine the gravity effects of surface deformation and subsurface mass change that must be separated in CO<sub>2</sub> storage site studies.

These limitations can be overcome by integrated gravimetric and geodetic technologies. The GWR Instruments Inc.'s superconducting gravimeter (SG), which uses a magnetically levitated sphere as a test mass, has considerably lower and linear drift ( $\leq 0.5 \mu\text{Gal}/\text{month}$ ,  $\mu\text{Gal} = 10^{-8} \text{ meter}/\text{sec}^2$ ) and much higher sensitivity (0.001 and 0.05  $\mu\text{Gal}$  in the frequency and time domains, respectively) than spring or absolute gravimeters. With these attributes, the SG provides precise and continuous records of gravity variations over times to periods of decades that are required for monitoring subsurface CO<sub>2</sub> storage.

In principle, the SG measured gravity includes two components: 1) deformation of the Earth's surface, and 2) mass change (variation in the distribution and density of mass). Therefore, by integrating the gravity

and the geodetic methods that can detect the deformation part only, we can separate gravity effects caused by the mass changes from those by the surface deformation. A gravity effect of 1  $\mu\text{Gal}$  corresponds to about 1.7 mm of vertical surface displacement, which can be measured by the integrated geodetic methods; and, a separation of the surface displacement from the mass movement and mass density change induced gravity becomes possible.

Last year, a grant of nearly one million Canadian dollars was awarded by Carbon Management Canada (CMC) to my proposal, "Integrated gravimetric and geodetic monitoring of geological carbon dioxide storage". In addition to the CMC's support for operation of the project, Tecterra Inc. supports SG and absolute gravimeter (worth  $\approx \$740\text{K}$ ) for this project (Figure: SG in the middle and absolute gravimeter in the right supported by Tecterra Inc., installed in Engineering building E30). In this innovative research, I proposed to monitor subsurface mass redistribution and leakage from geological CO<sub>2</sub> storage by integrated gravimetric and geodetic technologies. The SG is a key instrument for measuring time-varying gravity, which is supported by absolute and spring gravimeters for four-dimensional gravity and subsurface modeling. In addition to subsurface mass change and movement, the gravity measurements include the gravity effects from surface deformations associated with injection, migration and leakage at a CO<sub>2</sub> storage site. To analyze the displacement, geodetic techniques, such as persistent scatterer InSAR (PSInSAR), fully polarimetric SAR

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## Alumni Voice

During my time of studies I was not fully aware of the opportunity that is available for a geomatics engineer graduate. Since graduating in 2011 I have been working for Talisman Energy as a Geomatics Engineer in Training. Working in the international exploration department I am responsible for making sure that best practices with regard to spatial data are echoed throughout the company. Talisman's situation is not unique; throughout various stages of the petroleum industry there is a need for geomatics engineers.

My favorite thing about the Geomatics Engineering department was the sense of

community that forms between students. We are one of the smaller engineering faculties and get to know each other pretty well (it's no surprise that the geomatics engineering students were recently crowned ENGG week champions). Another great thing about the department was the passion of the faculty members, students could not help but to feel inspired by having world renowned experts of various fields give us lectures on a daily basis.

I found out that the geomatics engineering program opens a lot of doors to its graduates, among my graduating class the various job sectors that my classmates went

into include: software development, remote sensing, petroleum project management, GNSS navigation, transportation fleet management systems, and others. The future of Geomatics engineers looks really good on both the local scale and a worldly scale, it is a rewarding career path and I would recommend it without any hesitation to anyone interested.



Roman Abdoullaev, BSc 2011





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(PolSAR), in-ground tiltmeter grid and a global navigation satellite system (GNSS) network, are integrated with gravity.

The persistent scatterer InSAR (PSInSAR) and small baseline subset (SBAS) InSAR technologies will be used to monitor the millimeter level surface deformation; and, the results will be compared with the synchronized gravity anomalies maps from integrated gravimetric measurements. The SBAS InSAR is appropriate for monitoring the temporal evolution of deformation and uses a combination of differential interferograms to decrease baseline decorrelation. For this research, I proposed to use C-band RADARSAT-2 data and other available SAR data. Among the several available SAR satellites with different frequencies, C-band RADARSAT-2 is one of the best calibrated and most sophisticated with selectable imaging modes. In addition to natural radar reflectors available in the research area, a number of artificial metal corner reflectors for fine beam mode RADARSAT-2 will be installed as reference points.

The Korean government recently decided to build two geological CO<sub>2</sub> storages simultaneously in the southeastern part of the Korean Peninsula, one offshore and one onshore. JWK's two proposals, "Project development and implementation for Korean offshore geological CO<sub>2</sub> storage demonstration" and "Site selection, characterization and monitoring of subsurface CO<sub>2</sub> storage in Korea" have been accepted, respectively, by Korea National Oil Cooperation and by Korea Ministry of Education, Science and Technology, and the budgets are currently being revised. The two projects will begin in this summer.

## Department Activities

- GELC Meeting was held February 01, 2012
- Awards Night was held March 14, 2012
- GEAC meeting was held March 15, 2012



Geomatics Career Day—Feb 02, 2012



Melissa say's goodbye to 'Geomatics' and say's hello to the 'Centre for International Students and Study Abroad'. We wish you well!

## Coming Events

- Hands-On Direct and Integrated Sensor Orientation—two day short course at The University of Calgary *actual room TBA*). June 4-5 2012. Instructor: Dr Jan Skaloud, École Polytechnique Fédérale de Lausanne, Switzerland. Format: lecture and practical lab exercises. Cost: free. For registration and the course description, see <http://www.geomatics.ucalgary.ca/>
- Block Party Event—May 24, 2012
- Survey Camp—August 20-29, 2012

### Sites to Visit:

- <http://gess.geomatics.ucalgary.ca/>
- <http://jwkim.geomatics.ucalgary.ca/>
- <http://www.talisman-energy.com/>