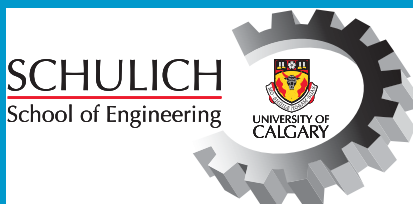


DEPARTMENT OF GEOMATICS ENGINEERING



PROGRESS REPORT 2004/2005

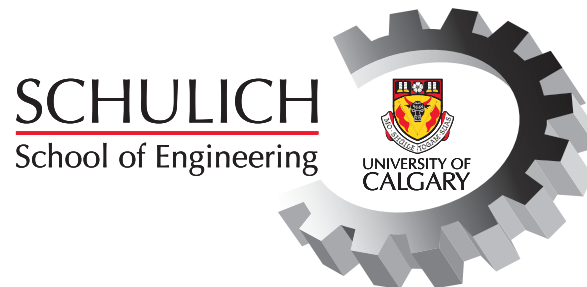


UCGE
Number 50036



PROGRESS REPORT 2004/2005

**DEPARTMENT OF
GEOMATICS ENGINEERING**



Schulich School of Engineering

May 2005

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Cover Photo:

A corner reflector deployed at Reindeer Station, on the east channel of the Mackenzie River, to improve backscatter correlation from Radarsat-1 and Envisat and to provide geo-referencing for the resulting interferograms.

Photo By: Dr. Matthew Tait



**Admitted to the Degree of
BACHELOR OF SCIENCE**

*Christopher Kawika Ashton (With Distinction)
(Internship)*

Kyle Arthur Beck

Michael Andrew Broadbent (Internship)

Luke Alan Dixon

*Lindsay Ann Forrester (With Distinction)
(Internship)*

Matthew William Forsyth

Michael John Fraser (With Distinction) (Internship)



*Jerrad Matthew Gerein
Colin Brian Huber (With Distinction) (Internship)*

Byron Dean Laurie

Aaron Robert Lloyd (Internship)

Sachin Kumar Mahendru

Benjamin Jamieson Matthews

Donald Albert Lester McKee (With Distinction)

Irwindeep Singh Natt

Jeffrey Allan Olsen

*Johnathon Rasmussen (With Distinction)
(Internship)*

Nathan Jozef Sikkes

Michael Andrew Thompson (Internship)

John Ka Lung Tong (Internship)

*Michael John Wollersheim (With Distinction)
(Internship)*

Ernest Siew-Pui Yap (Internship)

Jonathan David Hooper (Internship)

Andrea Maria Latos (Internship)

Warren Alexander Lippitt

Nghia Thanh John Luu

Vivianne Lai On Mansour (Internship)

Jesse William Mauch

*Andrew Jordan Nastiuk (With Distinction)
(Internship)*

Sara Jane Prescott (Internship)

Lesley Anne Sick

Robert Daniel Staniforth

Charles Li-Hsing Teng

Natasha Cecile Tippett (Internship)

Jason Chi-Yang Wong (Internship)

*Diana Ying Di Yang (With Distinction)
(Internship)*

Kambiz Yazdani (Internship)

**Admitted to the Degree of
MASTER OF ENGINEERING**

Joseph John Angelo

**Admitted to the Degree of
MASTER OF SCIENCE**

Yong Won Ahn

Diep Thi Hong Dao

Haiying Hou

Alan Wing Lun Ip

Suen Man Lee

Bijoy Paul

Todd A. Richert

Jayanti Sharma

John Robert Alexander Watson

Scott Alan Crawford

Sameet Mangesh Deshpande

Victoria A. Hoyle

Zhi Jiang

Ping Lian

Anoop Manohar Pullivelli

Anastassia Salytcheva

Landra Karolyi Trevis

David Bruce Wright

**Admitted to the Degree of
DOCTOR OF PHILOSOPHY**

Mudiyanselage Chaminda Basnayake

Paulo Roberto S. Alves

Kai-Wei Chiang

Oleg Alexander Mezentsev

Walid M. Nour-Eldin Abdel-Hamid

Kongzhe Chen

Shin Eun Hwan

Michel Fawzy Morgan

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HIGHLIGHTS 2004/2005

2004 marked the 25th Anniversary of the Department of Geomatics Engineering at the University of Calgary. The Department was established in 1979, as a result of the foresight and persistence of the surveying profession in western Canada. It has since grown into one of the largest geomatics programs world-wide by offering a broad-based undergraduate program combined with an outstanding graduate program specializing in five streams.

During 2004-2005, the Geomatics Engineering program continued to flourish. A total of 37 students received their BSc degree, 18 students their MSc degree, 1 student their MEng, and 8 students received their PhD. Undergraduate enrolment reached 57, 50 and 44 in each successive year of the undergraduate program, in addition to 26 students who entered the Internship Program. Demand for our BSc, MSc and PhD graduands remains exceptionally strong, particularly given the growth in the geomatics sector in Alberta.

This year brought a change to leadership in the Department. On July 1st, Dr. Naser El-Sheimy completed his term as Interim Department Head, and Dr. Elizabeth Cannon began a five-year term.

The number of full-time faculty members grew to 19, with the addition of three new faculty

member in 2004/2005: Dr. Alexander Braun joined the Department in October, coming from the Laboratory of Space Geodesy and Remote Sensing and the Byrd Polar Research Center, The Ohio State University; Dr. Bo Huang joined us as an Associate Professor in July from the Department of Civil Engineering, National University of Singapore; and Dr. Kyle O'Keefe completed his PhD at the University of Calgary and became a new Assistant Professor in July.

The 2004-2005 fiscal period was another very successful year from a research excellence point of view. Faculty members have continued to secure major research funding. Total direct research funding exceeded \$3.6 million, which is approximately \$192,000 in average research funding per faculty member. Numerous awards were received by students and faculty members which are detailed on the following pages. Several faculty members continued to serve in leadership positions on various boards and in learned societies.

A highlight for the year was the Department's 25th Anniversary Celebrations which were held in October, and which provided a strong focal point to draw students, faculty, alumni and external supporters to the University. A Celebration Banquet was held on October 28 with 275 faculty, staff, alumni, donors and supporters in attendance, and on October 29 an Open House showcased the Department's facilities and research programs. About 20% of our undergraduate alumni attended our Celebrations Banquet which is a testament to the strong support that we enjoy from the community.



Elizabeth Cannon thanks Naser El-Sheimy for being Interim Head, July 1 2003 to June 30, 2004

A legacy of this special event was the establishment of three 25th Anniversary Bursaries for each of our second, third and fourth year programs. The original goal of \$60,000 was far exceeded by raising \$120,000 for these bursaries, valued at \$3,000 each. We thank our faculty, alumni and external stakeholders for this support.

The Department is continuing in its commitment to excellence and growth in the undergraduate and graduate programs. Several initiatives are being developed to further enhance our teaching and research programs, so 2005/06 promises to be another exciting year!



*Five former and current Heads of Geomatics Engineering
Back Row L to R: M.E. Cannon, N. El-Sheimy, G. Lachapelle
Front Row L to R: K.P. Schwarz, E. Krakiwsky*

Dr. M. Elizabeth Cannon
Professor and Head
Geomatics Engineering

MESSAGE FROM THE DEAN

I am pleased to provide this letter for the Geomatics Engineering progress report for 2004/05. Under Dr. Elizabeth Cannon's leadership the Department continues to set a high standard of excellence in all aspects of its operations. The major international recognitions received such as the Kepler Award and an Honorary Degree exemplify the tributes of the international community to our leading researchers. Along with senior professors and a significant number of superb new academics, the department continues to excel in research, in post graduate studies as well in the undergraduate program. We are now

suppliers of highly qualified people not only to the surveying profession but to the larger Geomatics industry from Canada to California and the world. I wish the Department the very best in 2005/06.



Dr. Chan Wirasinghe, Dean
Schulich School of Engineering

AWARDS AND RECOGNITION

Michel Morgan, Ph.D. candidate, has been awarded the 2004 ASPRS Robert E. Altenhofen Memorial Scholarship. The Scholarship is intended to encourage and commend college students who display exceptional interest and ability in the theoretical aspects of Photogrammetry.

Dr. Elizabeth Cannon was selected along with **Dr. Judy Lupart** to receive the 2004 *WEPAN Betty Vetter Award for Research*. Dr. Lupart is the Canada Research Chair in Special Education at the University of Alberta.

Dr. Susan Skone has won the best presentation award at GNSS04 for her presentation *Wide Area Navigation Algorithm for Marine Users* given at the GNSS04 conference in Rotterdam May 17-19. In total 135 papers were presented and one winner was selected.

Dr. Elizabeth Cannon was elected Fellow of the U.S.-based Institute of Navigation during the annual meeting of the Institute held in Dayton, Ohio, June 7-9, in recognition of her sustained contributions in the field of global navigation satellite systems and related educational and community accomplishments.

Dr. Ayman Habib, with **Dr. Rami Al-Ruzouq**, a recent PhD graduand, received the Best Poster Award by the Twentieth International ISPRS Congress, Istanbul, Turkey. The award was presented for the paper titled *Automatic Registration and Change Detection of Multi-Source Imagery with Varying Geometric & Radiometric Properties*.

Dr. Elizabeth Cannon was elected a Fellow of the Royal Society of Canada. Fellows of the Royal Society are noted for their dedication to achieving excellence in their endeavours.

Dr. Bo Huang was appointed Guest Professor of the State Key Laboratory of Information Engineering in Surveying, Mapping, Remote Sensing, Wuhan University, China.

Kai-Wei Chiang, PhD candidate, won the 1st Student Paper Competition of the CPGPS (The International Association of Chinese Professionals in Global Positioning System) for his paper *Development of an Optimal GPS/MEMS Integration Architecture for Land Vehicle Navigation Utilizing Neural Network*.

Dr. Michael G. Sideris, was conferred the degree of Doctor Honoris Causa by the University of Architecture, Civil Engineering and Geodesy in Bulgaria. in Sofia on September 13, 2004.

Dr. Mike Barry was invited to be a new Director to the Board of Directors of the FIG Foundation.

Chris Goodall, M.Sc. Student, was awarded the Alberta Land Surveyors' Association Graduate Studies Scholarship.

Jayanti Sharma, M.Sc. student, has been awarded the Sir James Lougheed Scholarship and a scholarship from the German exchange office, in anticipation of her Ph.D. studies at the DLR-German Aerospace Center in Munich, Germany.

Dr. Matthew Tait received an Imperial Oil Research grant for his project entitled *Monitoring Permafrost Deformation in the Mackenzie Delta*. This project will follow up on Dr Tait's previous metrology work in the NWT.

Dr. Gérard Lachapelle, **Dr. M. Elizabeth Cannon**, **Adjunct Professor Richard Klukas**, and **Sanjeet Singh** and **Rob Watson** have been selected as this year's recipient of the Canadian Aeronautics and Space Institute Casey Baldwin Award. The paper was co-authored by Spirent personnel Peter Boulton, Arnie Read and Ken Jones, Apr 2005.

Dr. Gérard Lachapelle received the 2004-05 Faculty of Engineering Graduate Education Award.

AWARDS AND RECOGNITION, continued

Dr. Naser El-Sheimy won a Teaching Excellence Award from the second year Engineering students for his teaching of ENGO 361.

Dr. Ayman Habib won the Geomatics Engineering Teaching Excellence Award from the fourth year Engineering students.

Dr. Naser El-Sheimy was awarded the APEGGA Excellence in Education Award for exemplary contributions to teaching and learning.

Chen Xu, Ph.D. candidate, won the Best Student Paper in the session "Gravity field modeling from satellite missions" at the IAG International Symposium "Gravity, Geoid and Space Missions—2004", in Porto, Portugal. The award was presented for the paper *Analysis of J2 perturbed relative orbits for satellite formation flying*, co-authored by **Chen, Raymond Tsoi** and **Dr. Sneeuw**.

Qiaoping Zhang, Ph.D. candidate, was chosen by GEOIDE to participate in the Vespucci's Summer School, Italy, in the summer of 2005.

Walid Abdel Hamid and **Matthias Weigelt**, both Ph.D. candidates, won "Best Presentation Awards" at the First Annual Faculty of Engineering Graduate Student Research Conference for the *Instrumentation & MEMS* and the *Mathematical Techniques* Streams respectively.

Jau-Hsiung, Ph.D. candidate, was awarded the Sangster Award from CODATA at their 19th International Conference in Berlin, Germany, November 2004. Jau-Hsiung presented a paper entitled: "*Fuzzy Logic Expert Rule-based Multi-sensor Data Fusion for Land Vehicle Attitude Estimation*"

Landra Trevis, MSc student, and **Dr. Naser El-Sheimy** were presented the Best Paper Award for the Youth Sessions by the Twentieth International ISPRS Congress, in July 2004 in Istanbul Turkey. Their paper was entitled: "*The Development of a Real-Time Forest Fire Monitoring and Management System*".

Nine graduate students won Student Sponsorship Awards to present their papers at the Institute of Navigation's GNSS-04 Conference held in Long Beach, CA in September of 2004:

Sameet Deshpande, *Modulated Signal Interference in GPS Acquisition*

Salman Syed, *GPS Based Map Matching in the Pseudorange Measurement Domain*

James Wang, *The Aiding of a Low-Cost MEMS INS for Land Vehicle Navigation Using Fuzzy Logic Expert System*

Chaminda Basnayake, *Automated Traffic Incident Detection with GPS Equipped Probe Vehicles*

Walid Abdel-Hamid, *An ANFIS-Based Modeling of Thermal Drift of MEMS-Based Inertial Sensors*

Eun-Hwan Shin, *A Quaternion-Based Unscented Kalman Filter for the Integration of GPS and MEMS INS*

Oleg Mezentsev, *Self-Contained Sensor Aided Kinematic HSGPS Positioning Algorithm*

Mohamed Abdel-Salam, *A Hybrid Solution to Reduce the Long Convergence Time in Precise Point Positioning*

Dr. Yang Gao has been appointed Luojia Chair Professor of Wuhan University of China. This appointment will further strengthen the academic collaboration between Wuhan University and the University of Calgary in the field of Geomatics Engineering.

Dr. G. Lachapelle received 2004 Outstanding Leadership in Alberta Technology, Alberta Science and Technology (ASTech) Leadership Foundation, October, 2004

PERSONNEL

Faculty



Dr. M.E. Cannon
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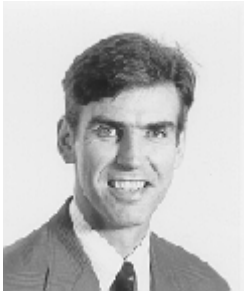
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Diplom-Geophysiker, Dr. phil. nat. (geophysics, magna cum laude, Johann Wolfgang Goethe-Universität Frankfurt)
Byrd Fellow (The Ohio State University)
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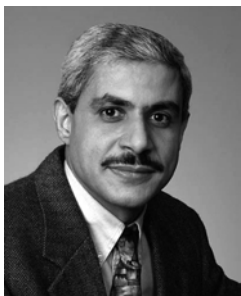
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Faculty Changes

Dr. Bo Huang was appointed to a faculty position in the area of Geospatial Information Systems on July 1, 2004. Dr. Huang holds a B.Eng. in Urban Survey, Planning and Management from Wuhan Technical University of Surveying and Mapping, China, an M.Sc. in Urban GIS, from the International Institute for Aerospace Survey and Earth Sciences (ITC), the Netherlands, and a PhD degree in Remote Sensing and Mapping from the Chinese Academy of Sciences.

After his PhD degree, he conducted post-doctoral research in the Department of Computer Science, Keele University, UK and the Joint Laboratory of GeoInformation Science, the Chinese University of Hong Kong for 1.5 and 2 years, respectively. More recently, Dr. Huang was an Assistant Professor in the Department of Civil Engineering, National University of Singapore.

Since 1989, Dr. Huang has been pioneering and participating in a number of GIS related projects. The findings from these projects have been published in leading GIS and Computer Science journals such as International Journal of GIS, GeoInformatica, and IEEE Transactions on Knowledge and Data Engineering. He was the co-chair and the chair of the First and Second International Workshops on Web and Wireless GIS, respectively.

Dr. Huang's current research interest focus on spatio-temporal data modeling and query language, mobile computing for location-based service and the integration of GIS with advanced heuristics for transportation and logistics applications.



Dr. Kyle O'Keefe was appointed to a faculty position in the area of Wireless Location, and began working in the Department of Geomatics Engineering as of July 1, 2004.

Dr. O'Keefe holds a BSc in Honours Physics from the University of British Columbia. In 1997, he joined the Department of Geomatics Engineering at the University of Calgary at the undergraduate level and received a second BSc degree in 2000. Kyle enrolled in the graduate program at the University of Calgary in May 2000 and completed his Ph.D. in April 2004. He has won several teaching awards including being chosen Geomatics Engineering Professor of the Year by the 2004 graduating class for his work as the instructor in ENGO 561. His research interests include Wireless Location, RF signal propagation measurement and simulation, navigation system performance simulation and evaluation, and estimation theory.



Kyle O'Keefe's PhD Dissertation Committee
 Back Row (L to R): W. Cannon, M.E. Cannon, P. Wu
 Front Row (L to R): S. Skone, Kyle O'Keefe, G. Lachapelle

Dr. Alexander Braun was appointed as an Assistant Professor in the area of Geodesy, in September 2004.

Dr. Braun holds a PhD (magna cum laude) in Geophysics from the University of Frankfurt. He is both a geodesist and geoscientist with a strong background in the interdisciplinary field of space geodesy, geodynamics and geophysics. Dr. Braun's current research is focused on the application of space geodetic data in monitoring crustal deformation, sea ice and sea level change. In particular, satellite altimetry using both laser and radar sensors, and geodynamic modeling, are part of his expertise.



Dr. Alexander Braun at White Island marine volcano off the coast of New Zealand

Dr. Braun was a research scientist at the GeoForschungsZentrum Potsdam, Germany for four years. Prior to coming to the University of Calgary, he was a Byrd Fellow and senior research associate at the Laboratory of Space Geodesy and Remote Sensing and the Byrd Polar Research Center, of The Ohio State University.



Geomatics Engineering Faculty Members at the Annual Retreat Spring, 2004

Back row: N. Sneeuw, M. Barry, C. Kotsakis
Middle Row: M. Sideris, C. Valeo, S. Skone, G. Lachapelle, I. Couloigner, M. Rakai
Front Row: B. Teskey, A. Habib, Y. Gao, N. El-Sheimy, E. Cannon, M. Tait
Missing: A. Braun, M. Collins, B. Huang, D. Mioc

Professors Emeritus

Dr. J.A.R. Blais, Ph.D. (University of New Brunswick), P.Eng. Estimation, spectral analysis, information theory and systems numerical methods, reference systems and gravitation.

Dr. E.J. Krakiwsky, Ph.D. (Heiskanen Award; The Ohio State University), P.Eng. Least squares estimation and statistical testing, network design, satellite positioning, automatic vehicle location and navigation systems.

Dr. A.C. McEwen, Ph.D. (University of London), C.L.S., N.L.S., Cadastral studies, survey law, land registration systems, international land and maritime boundaries surveys for aboriginal land claims.

Dr. K.P. Schwarz, Dr.-Ing. (Summa cum laude; Technical University of Berlin), P.Eng., Geodesy, inertial techniques, airborne gravimetry, kinematic positioning and attitude determination by GPS/INS, multi-sensor systems, real-time applications.

Adjunct Professors

Dr. Richard Klukas
Okanagan University College

Dr. Chuck Livingstone
Defence Research and Development Canada

Dr. Aboelmagd Noureldin
Royal Military College of Canada

Dr. Bruno Scherzinger
Applanix Corporation

Support Staff Administrative

Ms. Marguerite Anderson, Administrative Manager

Ms. Monica Barbaro, Administrative Secretary

Ms. Julia Lai, Administrative Secretary

Ms. Lu-Anne Markland, Graduate Program Administrator

Ms. Tamara McCarron, B.Sc, Women in Science and Engineering Coordinator and Director, SCIBerMENTOR Program

Technical

Mr. Kirk Collins, B.Sc, Dipl. Surveying & Mapping Technology, Survey Technician

Mr. Brad Groat, B.A., Dipl. in Electronics Engineering Technology, Computer Systems Administrator

Ms. Kathy Hamilton, Network Technican Certificate, Computer Technician

Ms. Gail Leask, Dipl. in Telecomputer Engineering Technology, Microcomputer Lab Administrator

Mr. Garth Wanamaker, B.Sc, Technical Manager

Research Associates/Assistants

Walid Abdel-Hamid
Positioning, Location and Navigation

Chaminda Basnayake
Positioning, Location and Navigation

Kai-Wei Chiang
Positioning, Location and Navigation

Lei Dong
Positioning, Location and Navigation

Rossen Grebenitcharsky
Gravity Field and Geodynamics

Zhi Jiang
Positioning, Location and Navigation

Martin Lavigne
Positioning, Location and Navigation

Ning Luo
Positioning, Location and Navigation

Michel Morgan
Digital Imaging Systems

Changlin Ma
Positioning, Location and Navigation

Mark Petovello
Positioning, Location and Navigation

Anastasia Salycheva
Positioning, Location and Navigation

John Schleppe
Positioning, Location and Navigation

Sudhir Shrestha
Positioning, Location and Navigation

Muhammad Soofi
Gravity Field and Geodynamics

Bruce Wright
Positioning, Location and Navigation



Campus Fair Team June, 2004

Post Doctoral Fellows

Georgia Fotopoulos
Gravity Field and Geodynamics

Eui Myoung Kim
Digital Imaging Systems

Zhizhao Liu
Positioning, Location and Navigation

Sameh Nassar
Positioning, Location and Navigation

Xiao Ji Niu
Positioning, Location and Navigation

Yufeng Zhang
Positioning, Location and Navigation

Guest Lecturers

DISTINGUISHED LECTURE SERIES

Dr. John Raquet

Air Force Institute of Technology, Dayton, Ohio
GPS Receiver Design Course

Dr. Bruno Scherzinger

Applanix Corporation
Estimation with Application to Navigation

Dr. Anton F. Schenk

Ohio State University
Hyperspectral Imagery and Fusion



Dr. Anton Schenk and Graduate Students

INTERNATIONAL LECTURE SERIES

Anna B.O. Jensen

University of Aalborg, Denmark
*Numerical Weather Predictions for
GPS Positioning*

Professor Helmut Moritz

Graz Technical University
*GPS and the Gravity Field: Theory and
Engineering Applications
Relativistic Effects in Geodesy
Inverse Problems in Geodesy and Geophysics*

Dr. Takayuki Yoshihara

ENRI, Japan
*Airborne-based GPS Down-looking Occultation
Experiments*

Visiting Scientists

Mr. Arne Dietrich

Robert Bosch Corporation

Dr. Marc D'Iorio

Canada Centre for Remote Sensing (CCRS),
Natural Resources Canada

Dr. Hans-Jürgen Euler

Leica Geosystems AG

Alberto Guarnieri

University of Padua, Italy

Professor Chang-Hahk Hahm

Inha Technical College, Incheon, Korea

Mr. Irvin Itzkovitch

Assistant Deputy Minister, Earth Science
Sector, NRCan

Mr. Jim King

Communications Research Centre

SPECIAL LECTURE SERIES

Dr. Alexander Braun

Ohio State University
*ICESat Laser Altimetry: Expectations, Applications
and Results*

Dr. Alex Bruton

Intermap Technologies
*A Perspective on the Challenges in Geodesy
and Ways to Meet Those Challenges*

Dr. Michael Kern

Graz University of Technology
*External Calibration and Validation Methods
for the Satellite Mission GOCE*

Dr. Danielle Marceau

University of Montréal
*Spatio-Temporal Object-Oriented GIS Modeling and
Geovisualization:
Applications for Environmental Management
Spatio-Temporal Modeling of Ecosystems for
Environmental Management:
Research Issues and Contributions.*

Professor Edson Mitishita

Federal University of Paraná (UFPR),
Curitiba, Brazil

Mr. Paul Mrstik

Terrapoint, Ottawa

Mr. Adrian Taylor

DND

Tohru Yotsumata

PASCO Corporation of Tokyo, Japan

Group of researchers

Ulsan University, Korea

Group of research engineers

FreeFlight Systems, USA

ADVISORY COMMITTEE AND STUDENT AWARDS Advisory Committee

It is the responsibility of the Geomatics Engineering Advisory Committee to ensure that the undergraduate, graduate and research programs meet the needs of the country and are kept up to date with society and the rapidly changing technologies.

The 28th annual advisory committee meeting was held on Friday, October 29, 2004. The agenda included discussions on the curriculum redesign for the 2005/06 calendar year, Career Day 2005, University budget cuts and reallocation opportunities, and career opportunity diversification for Geomatics graduates. Issues surrounding growing the receptor capacity for graduate students, and providing professional development workshops were also discussed.



*Back L to R: Bruno Scherzinger, Paul Mrstik, Mike Barry, Irwin Itzkovitch, Robert Parkinson, Amin Kassam
Middle L to R: Susan Skone, Bill Pointon, Tim Koepke, Pat Fenton
Front L to R: Bryan Bates, O'Brian Blackall, Elizabeth Cannon, Sara Masterson*

Advisory Committee 2004

Name	Affiliation
O'Brian Blackall, Chair	McElhanney Land Surveying Inc.
Bryan Bates	CanAm Geomatics Corp.
Pat Fenton	NovAtel Inc.
Irwin Itzkovitch	Earth Science Sector, Natural Resources Canada
Amin Kassam	B.C. Government
Tim Koepke	Indian and Northern Affairs
Sara Masterson	NovAtel Inc.
Paul Mrstik	Mosaic Mapping Systems Inc.
Robert Parkinson	Agriculture and Agri-Food Canada
Bill Pointon	Fugro SESL Geomatics Ltd.
Bruno Scherzinger	Applanix Corporation
Representatives of the U of C were M.E. Cannon, M.B. Barry, S.H. Skone	

Geomatics Engineering Liaison Committee

The Geomatics Engineering Liaison Committee met on October 28, 2004 and February 7, 2005. The committee was established to develop an effective and permanent relationship between the Land Surveyors' Associations and the University of Calgary. The committee consists of two delegates each from the Land Surveying Associations in the four western provinces and the Association of Canada Lands Surveyors, a member at large, as well as the Associates Heads and Cadastral faculty of the Department of Geomatics Engineering at the University of Calgary.

Geomatics Engineering Liaison Committee 2004	
Name	Affiliation
Bryan Bates	Member at Large
Paul Dixon	Association of Canada Lands Surveyors
Robert King	Alberta Land Surveyors Association
Ian Lloyd	Association of Canada Lands Surveyors
Rich Redfern	Corporation of British Columbia Land Surveyors
Jeffrey Skelton	Saskatchewan Land Surveyors Association
Paul Standing	Association of Manitoba Land Surveyors
Vince Ziegler	Alberta Land Surveyors Association

Representatives of the U of C were M.B. Barry (Chair), M.E. Cannon, M.E. Rakai, W.F. Teskey

Discussions centered around educational tools for high school students which use surveying theory and practice, how these outreach programs can be coordinated, and recommended work tasks that summer and internship students should be exposed to during work experience.



25th Anniversary Celebration
Lost Peg Contest

Student Awards Night and 25th Anniversary Celebrations

The Department of Geomatics Engineering celebrated its 25th Anniversary on October 28 and 29, 2004 with great success. A Celebration Banquet was held on October 28 with 275 faculty, staff, alumni, donors and supporters in attendance. There was representation from all graduating classes, 1981 – 2004 and over 20% of the undergraduate alumni were in attendance. Numerous displays showing graduating class photos and other memorabilia provided an opportunity for alumni to connect with each other and share memories from their student days. Undergraduate and graduate award winners for 2004/2005 were also recognized.



Susan Ross, Stephen Green BSc '82, Brian Ross BSc '83

On October 29 there was an Open House which showcased the Department's facilities and research programs. A Lost Peg game was held in which teams used GPS geocaching and conventional surveying to locate a 'lost peg' on campus. The game was won by the "Class of '97" which included Rob Tupper, BCLS, Mark Budgen, PEng, Robb Isaac, PEng, and Lee Andersen, SLS, ALS. Richard Redfern, BCLS, and a member of the Geomatics Engineering Liaison Committee, rounded out the team. By locating the 'peg' to within 5 mm, the names of the team members will be engraved on the Department's Lost Peg trophy which is traditionally awarded each year at Survey Camp.



Lost Peg Winners (L to R): Rob Isaac BSc '97, Rob Tupper BSc '97, Mark Budgen BSc '97, Lee Anderson BSc '97,



Jenny Kwan BSc '90, Sandy Davies BSc '91, Elizabeth Natola BSc '90, MEng '97

A legacy of this special event was the establishment of three 25th Anniversary Bursaries for each of our second, third and fourth year programs. The original goal of \$60,000 was far exceeded by raising \$120,000 for these bursaries which are valued at \$3,000 each. Thanks to our many supporters and congratulations to the inaugural winners of the award: David Chiu, Angela Jeffray and Sidney Kwakkel.

Graduate Awards	
Kai-Wei Chiang Eun Hwan Shin	Innovation in Mobile Mapping Award
Rita Cheng	Dean's Research Excellence Award
Rita Cheng Natalya Nicholson	NSERC Scholarships
Rita Cheng Lance de Groot Olivier Julien	AIF Awards
Mahmoud El-Gizawy Andrew Hunter Todd Richert	NSERC Industrial Postgraduate Scholarship
Cameron Ellum Natalya Nicholson Todd Richert	Province of Alberta Graduate Fellowship
Andrew Hunter	Walker Newby
Natalya Nicholson	Mildred Shaw Book Prize
Natalya Nicholson	iCORE Supplement
Todd Richert	Alberta Ingenuity Award
Matthias Weigelt	Werner Graupe Scholarship
Qiaoping Zhang	Graduate Faculty Council Scholarship
Qiaoping Zhang	J.B. Hyne Graduate Scholarship
Qiaoping Zhang	Canadian Natural Resources Limited Graduate Scholarship
Olivier Julien	Institute of Navigation (ION) Alberta Section Graduate Scholarship
Oleg Mezentsev	Institute of Navigation (ION) National Section Graduate Scholarship

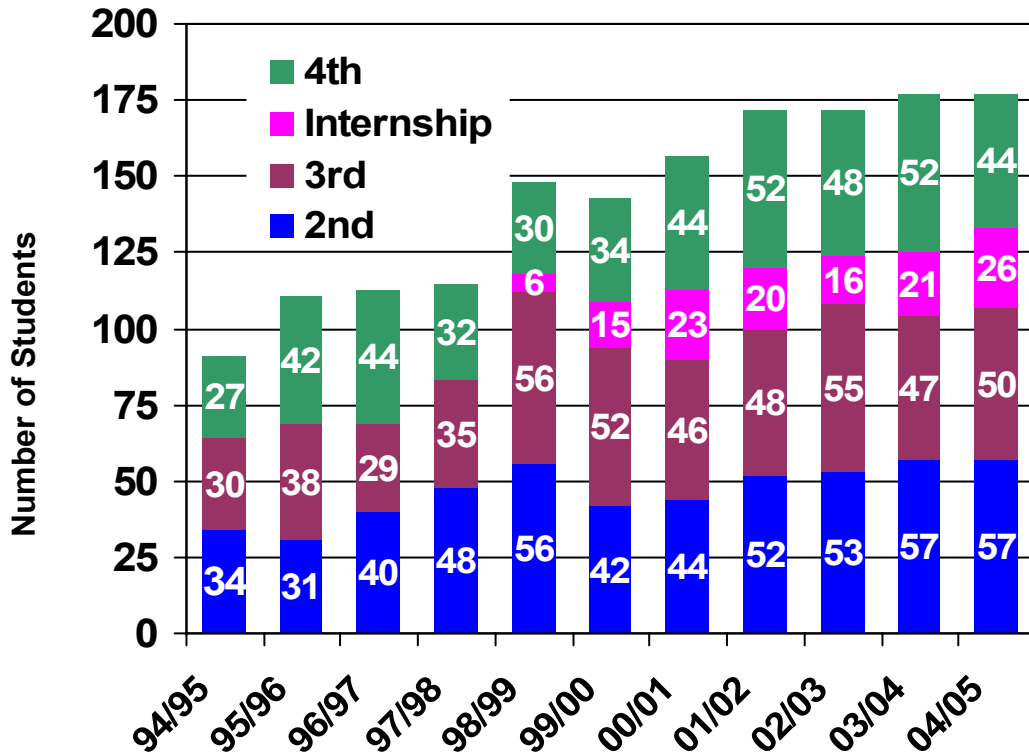


Awards Night
From Left: Sid Kwakkel, Olivier Julien, Oleg Mezentsev, and Mark Petovello

Geomatics Undergraduate Awards	
Recipient	Awards
Donald McKee	Alberta Land Surveyors' Association Scholarship
Benjamin Giesbrecht	British Columbia Land Surveyors Award
Sachin Mahendru	Colt Geomatic Solutions Ltd. Bursary
Trevor Phillips	Cannon-Lachapelle Family Scholarship
Byron Laurie	H. Roy Goldfinch Memorial Award
Tricia Christie	Bryan I. Dreger Award
Rachelle Larose	Focus Intec Geomatics Bursary
David Chiu Angela Jeffray Sidney Kwakkel	Geomatics Engineering 25th Anniversary Bursary
Desmond Chiu	Geomatics Engineering Future Leaders Award
Scott Anderson Carina Dunn	Geomatics Engineering Student Society Bursary
Norman Chan	A.D. (Denis) Hosford Scholarship
Carmen Wong	Institute of Navigation Alberta Chapter Bursary
Richard Ong	KIS97 Undergrad Scholarship
Carmen Wong	E.J. Krakiwsky Bursary
Angela Jeffray	LEICA Geosystems Limited Scholarship
Richard Ong	Ray Lowry Memorial Bursary
Benjamin Giesbrecht	McElhanney Scholarship
Joel Maduck	L.R. (Dick) Newby Memorial Award
Ashley Large	David Scovill Memorial Bursary
Kenneth Kitchen	Stephen P. Williams Memorial Award
Natasha Tippet	Jim Van Dam Scholarship
Donald McKee	J.H. Holloway Scholarship in Geomatics Engineering
Angela Jeffray Ashely Large	Institute of Navigation (ION) Undergraduate Bursary

UNDERGRADUATE STUDIES

Enrollment

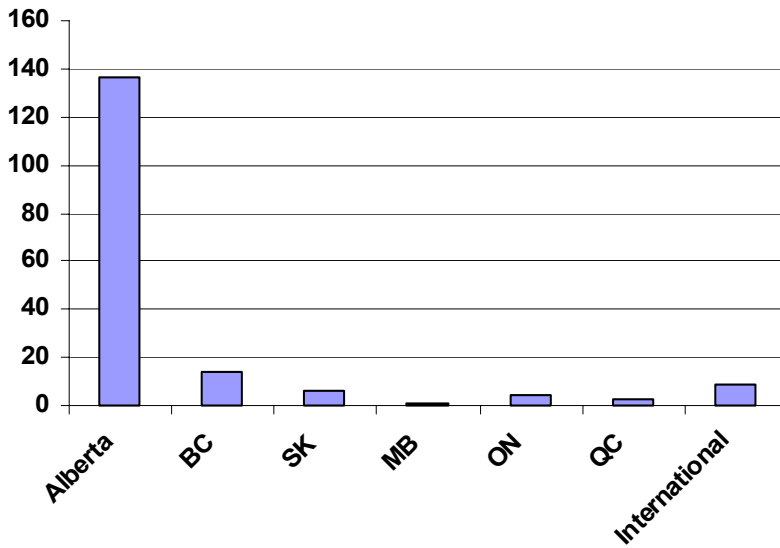


Undergraduate Enrollment 1994/95 to 2004/05

During the 2004/05 academic year, 151 undergraduate students (177 including internship) pursued studies in Geomatics Engineering at the University of Calgary.

Growth in undergraduate enrollment has leveled off the past two years, after consistent growth for the previous seven years. The program’s enrollment has almost doubled in the past ten years, with an average enrollment per year of 50 students in each of second, third and fourth year.

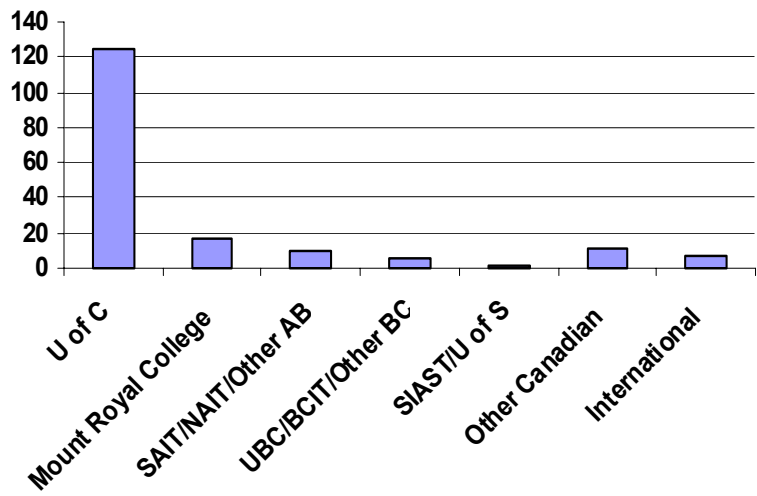
The 2004/05 year saw a record number of students pursuing Internship opportunities. Twenty-six students were placed in industry for a minimum of 12 months.



The figure to the left shows a breakdown of student enrollment by geographic region. Students from Alberta remain the largest group, and numbers from the other groups remain fairly constant from year to year.

Student Enrollment by Geographic Region

A representation of enrollment statistics by post-secondary institution is shown in the figure to the right. Alberta post-secondary institutions listed under The category 'Other AB' includes Medicine Hat and Lethbridge Community Colleges, Red Deer College and Prairie Bible College. 'Other BC' institutes include Kwantlen University College, Thompson Rivers University, and Trinity Western University. 'Other Canadian' includes Laval University, University of Quebec, Concordia University, University of Toronto, University of New Brunswick, Carleton University, and University of Western Ontario.



Student Enrollment by Previous Post-Secondary Institution

Common Core Curriculum

The common curriculum for engineering students is shown in the adjacent table.

Students choose their department at the end of the first year and begin studies specific to that department in the second term of second year.

Common Program for All Engineering Students		
Year 1	Course Number	Course Name
	AMAT 217	Calculus for Engineers and Scientists
	AMAT 219	Multivariable Calculus for Engineers
	CHEM 209	General Chemistry for Engineers
	ENGG 201	Behaviors of Liquids, Gases and Solids
	ENGG 205	Engineering Mechanics I
	ENGG 233	Computing for Engineers I
	ENGG 251	Design and Communications I
	ENGG 253	Design and Communications II
	MATH 221	Linear Algebra for Scientists and Engineers
	PHYS 259	Electricity and Magnetism
	COST -1	Complementary Studies Course
Year 2 (Fall)		
	AMAT 307	Differential Equations for Engineers
	ENGG 319	Probability and Statistics for Engineers
	ENGG 325	Electric Circuits and Systems
	ENGG 335	Computing for Engineers
	ENGG 349	Engineering Mechanics II
	PHYS 369	Acoustics, Optics and Radiation for Engineers
Abbreviations		
	AMAT	Dept. of Mathematics & Statistics
	CHEM	Dept. of Chemistry
	PHYS	Dept. of Physics
	ENGG	Faculty of Engineering
	ENGO	Dept. of Geomatics Engineering
	COST	Complementary Studies Course

Undergraduate Curriculum in Geomatics Engineering

Undergraduate Curriculum in Geomatics Engineering		
Year 2/Winter	Course	Core Area
	AMAT 309	Vector Calculus for Engineers
	ENEL 327	Signals and Transforms
	ENGO 343	Fundamentals of Surveying
	ENGO 351	Introduction to Geospatial Information Systems
	ENGO 361	Adjustment of Observations
		Surveying & Land Studies
		GIS
		Estimation & Data Analysis
Year 3/Fall	Course	Core Area
	ENCI 471	Introduction to Project Management
	ENGG 407	Numerical Methods in Engineering
	ENGO 421	Coordinate Systems
	ENGO 431	Analytical Photogrammetry
	ENGO 435	Remote Sensing
	COST 2	Complementary Study
		Estimation & Data Analysis
		Geodesy, Positioning & Navigation
		Digital Imaging Systems
		Digital Imaging Systems
Year 3/Winter	Course	Core Area
	ENGO 419	Geomatics Networks
	ENGO 423	Geodetic Positioning
	ENGO 427	Physical Geodesy
	ENGO 455	Land Tenure & Cadastral Systems
	COST-3	Complementary Study
		Methodology
		Geodesy, Positioning & Navigation
		Geodesy, Positioning & Navigation
		Surveying & Land Studies
Year 4/Fall	Course	Core Area
	ENGO 500	Geomatics Engineering Project
	ENGO 501	Field Surveys
	TE-1	Technical Elective
	TE-2	Technical Elective
	TE-3	Technical Elective
	COST-4	Complementary Study
		All Core Areas
		All Core Areas
Year 4/Winter	Course	Core Area
	ENGO 500	Geomatics Engineering Project
	COST-5	Complementary Study
	COST-6	Complementary Study
	TE-4	Technical Elective
	TE-5	Technical Elective
	TE-6	Technical Elective

**TECHNICAL ELECTIVES
GEOMATICS ENGINEERING**

Course		Core Area
BSEN 395	Legal Environment	Surveying & Land Studies
ENGO 545	Hydrography	Geodesy, Positioning & Navigation
ENGO 557	Design and Implementation of Geospatial Information Systems	GIS
ENGO 559	Digital Imaging and Applications	Digital Imaging Systems
ENGO 561	Satellite Positioning	Geodesy, Positioning & Navigation
ENGO 563	Data Analysis in Engineering	Estimation & Data Analysis
ENGO 567	High-Precision Surveys	Surveying & Land Studies
ENGO 573	Digital Terrain Modelling	Digital Imaging Systems
ENGO 579	Survey Law	Surveying & Land Studies
ENGO 581	Land Use Planning	Surveying & Land Studies
ENGO 583	Environmental Modelling	GIS

Geomatics Engineering Student Society (GESS)

President - Natasha Tippet
 VP Academic - Andrea Latos
 VP Events - Mike Broadbent
 Treasurer - Nathan Sikkes
 VP ESS/External - Glynn Stewart
 3rd Year Rep - BJ Houghton/Ammara Cokar
 4th Career Day - Tricia Christie
 3rd Career Day - Ashley Large/Mina Saleh



Engineering Week 2005

ENGO 500

The objective of the ENGO 500 group project course is the development of skills in cooperative research, report preparation and seminar presentation. Students plan and execute a project that must conform with professional requirements. The project must have design, measurement, analysis and presentation components. Submission and defence of progress reports and a final report are required. The Department awards a prize to the group with the best project. This year the winners were: Diana Yang, Johnathon Rasmussen and Mike Wollersheim.

ENGO 500 Special Presentations

Mr. Ian Getty

TELUS Geomatics

Connecting Geospatial Data to Information Systems.

TELUS Geomatics Constant Quest for Integration

Mr. Jason Humber

Integrated Informatics Inc.

Enhancing the Pipeline Route Selection Process

Dr. Gérard Lachapelle

University of Calgary

The Last Major High Accuracy Classical Geodetic Survey Operation Undertaken in Canada: The 1983 Rogers Pass Survey

Dr. Alex Bruton

Intermap Technologies

(Having Fun with) Project Management in Geomatics Engineering



25th Anniversary Celebration
Class Photo Displays

ENGO 500 Projects (2004/05)		
Project Title	Group Members	Supervisor
Appropriate Technologies for Recording Rural Land Rights in Mozambique	Aaron Lloyd Ben Giesbrecht Vidya Rangayyan Sara Prescott	M. Barry
High Precision Control Network at the University of Calgary	Kyle Beck Charles Teng Jason Wong Natasha Tippett	M.E. Cannon
Analysis of Indirect vs. Direct Georeferencing	Lindsay Forrester Ernest Yap Viviane Mansour Benjamin Matthews	N. El-Sheimy
Semi-Automated Urban Feature Extraction Using LiDAR	Diana Yang Johnathon Rasmussen Mike Wollersheim	A.F. Habib
Web-Based GIS Design Project	Cristopher Ashton Jerrad Gerein Kambiz Yazdani John Lui	D. Mioc
Land Redistribution of WID Land East of the City of Calgary	Lesley Sick Byron Laurie Warren Lippitt	M.E. Rakai
Augmentation of GPS with Pseudolites in Urban Environments	Michael Broadbent Andrew Nastiuk Colin Huber Mike Fraser	K. O'Keefe
The Use of Terrestrial Laser Scanning For Construction Survey	Robert Stainforth Sachin Mahendru Mike Thompson	M.P. Tait
The comparison of Different Methods to measure Deformations in a Large Roof Structure	Matt Forsyth Donald McKee Jeff Olsen Nathan Sikkes	W.F. Teskey
Web-based GIS Application	Andrea Latos Karl Guillotte John Tong	C. Valeo

Engineering Internship Program

Geomatics Engineering Internship Students 2004/05		
Name	Placement Company	Faculty Mentor
Anderson ; Scott William	Applanix Corporation	N. El-Sheimy
Beaugrand, Christopher	Usher Canada	B. Huang
Beck ; Michael Peter	Waypoint Consulting Inc.	K. O'Keefe
Berg, Erin	Syncrude Canada Ltd.	W.F. Teskey
Bryan ; Meredith Dawn	Stantec Consulting Ltd.	C. Valeo
Chan ; Norman	Midwest Surveys Inc.	M.B. Barry
Chiu ; David Sung-Tat	Applanix Corporation	K. O'Keefe
Deis ; Richard James	Challenger	C. Valeo
Dmitriev, Elena	CANA Construction	W.F. Teskey
Dobson ; Ryan Thomas	McElhanney	M.P. Tait
Edwards ; Daniel Lennon	Intermap Technologies Corporation	I. Couloigner
Ferguson ; Colin Michael	Precision Geomatics	S.H. Skone
Henry ; Cameron Powell	McElhanney Land Surveys Ltd.	M.E. Rakai
Heuchert, Michael	The MacKenzie Valley Land and Water Board	D. Mioc
Kitchen ; Kenneth Cole	Aerotec	D. Mioc
Larose ; Rachelle Anne	Fugro SESL Geomatics Ltd.	G. Lachapelle
Lee ; Dana Erin	Midwest Surveys Inc.	W.F. Teskey
Maduck ; Joel Anthony	Intermap Technologies Corporation	A.F. Habib
McNabb ; Kari-Ann	Midwest Surveys Inc.	I. Couloigner
Miller, Nicole	Maltais Geomatics	M.P. Tait
Setiawan, Jennifer	Focus Surveys Ltd.	A. Braun
Slen ; Scott Richard	Fugro SESL Geomatics Ltd.	A.F. Habib
Tingley ; Jonathan Michael	McElhanney Land Surveys Ltd.	M.E. Rakai
Walker ; Ryan James	The Cadastral Group Inc.	W.F. Teskey
Willms ; Timothy Ronald	Fugro SESL Geomatics Ltd.	M.P. Tait
Yuen ; Elaine	Autodesk Inc.	D. Mioc

This program offers an optional cooperative educational work experience for all students who have completed their third year of engineering. Participants spend 12 to 16 months in paid jobs.

In 2004/2005, 26 students were placed in the geomatics industry. This is the largest number of students from the Geomatics program ever to participate in the Engineering Internship Program.

Geomatics Engineering Career Day

On Tuesday, February 8, 2005, the Geomatics Engineering Student's Society and the Department of Geomatics Engineering hosted their ninth annual Career Day. Career Day provides a forum for both companies and students to interact and discuss topics and career opportunities in the Geomatics industry. Several guest speakers made presentations on various topics throughout the day. In addition to these presentations, students and company representatives participated in the Industry Showcase, which was introduced to provide all participants with an opportunity to discuss careers in Geomatics.

The Geomatics Engineering Student's Society would like to thank all participants and sponsors for making this year's Career Day a success.

Career Day Participants 2005	
ACLS	Intermap Technologies
All West Surveys Ltd.	Kodiak Nav. Solutions
All-Can Engineering and Surveys	McElhanney Land Surveys
ALSA	Millennium Geomatics Ltd.
Applanix Corp.	Sirf Technology
Assoc. of BC Land Surveyor	Stantec
Can-Am Geomatics Corp.	Stewart Weir Group
Challenger	The Cadastral Group Inc.
Colt Geomatics Solutions	Trimble Navigation
Crape Geomatics Corp.	Tripod Data Systems
CSI Wireless	Tuboscope Pipeline Services
Focus Corporation	Usher Canada Limited
Global Surveys Group	Waberski Darrow Survey Group
33 Field Engineer Squadron, Canadian Forces	

Geomatics Engineering Survey Camp at Kananaskis

An important part of the undergraduate degree program in Geomatics Engineering is the field camp (ENGO 501). This two week camp is held at the Kananaskis Centre for Environmental Research, prior to the start of the Fall Session. It gives incoming fourth year students the opportunity to apply the knowledge and experience gained in the different areas of geomatics to an integrated practical project.

The Department of Geomatics Engineering would like to thank the following companies for their participation in the annual Survey Camp Equipment Day, and for the generous loan of equipment over the duration of Survey Camp:

Butler Survey Supplies Ltd.
Cansel Survey Equipment
Southern Alberta Institute of Technology



Field Camp exercise– Precise Engineering Survey



Survey Camp August 2004

GRADUATE STUDIES

Enrollment

There were a total of 107 graduate students in Geomatics Engineering in 2004/2005 (96 full time and 11 part time). During the academic year 2004/2005, students were either enrolled in the graduate program or finishing their theses. Thirty-eight were working towards their PhD degree, 64 towards their MSc degree and 5 towards their MEng degree. Students originated from 14 different countries. There were 25 students that graduated during the reporting period, 6 with a PhD degree, 18 with a MSc and one with an MEng. Details are given in the following tables.

PhD Students 2004/2005			
Name	Supervisor	Name	Supervisor
Abdel-Hamid, Walid	El-Sheimy/Lachapelle	Kim, Changjae	Habib
Abdel-Salam, Mohamed	Gao	Konavattam, Surendran Shanmugam	Lachapelle/Nielsen
Aggarwal, Priyanka	El-Sheimy	Mao, Gang	Lachapelle/Cannon
Al-Rawas, Ghazi Ali	Valeo	Mezentsev, Oleg A	Lachapelle
Alves, Paul	Lachapelle/Cannon	Morgan, Michel	Habib
Basnayake, Chaminda	Lachapelle/MacIver	Nicholson, Natalya	Skone/Cannon
Chen, Kongzhe	Gao	Qiu, Haitao	Lachapelle
Chen, Zhiyu	Gao	Quinonez-Pinon, Rebeca	Valeo
Chiang, Kai-Wei	El-Sheimy	Raaflaub, Lynn Diane	Valeo
El-Gizawy, Mahmoud	El-Sheimy	Rangelova, Elena	Sideris
El-Habiby, Mohamed	Sideris	Shen, Xioabing (Jose)	Gao
Ellum, Cameron M.	El-Sheimy	Shin, Eun Hwan	El-Sheimy
Gao, Guo Jiang	Lachapelle	Wang, Jau-Hsiung (James)	Gao
Gao, Jianchen	Cannon	Whittal, Jennifer Frances	Barry
Ghanma, Mwafag	Habib	Xu, Chen	Sneeuw/Sideris
He, Jianxun (Jennifer)	Valeo	Zhang, Qiao Ping	Couloigner
Hunter, Andrew J. S	El-Sheimy/Mioc	Weigelt, Matthias L. B.	Sneeuw/Sideris
Julien, Olivier	Lachapelle/Cannon	Zheng, Bo	Lachapelle
Khan, Mohamed Khaleel Rhaman	Barry		

Full-Time MSc and MEng Students 2004/2005			
Name	Supervisor	Name	Supervisor
MSc Students			
Ahn, Yong Won	Lachapelle/ Skone	Mongredien, Cecile M.	Lachapelle/Cannon
Anderson, Teresa Marlene	El-Sheimy	Paul, Bijoy	Teskey
Charkhandeh, Shahin	Lachapelle/ Cannon	Phalke, Seema	Cannon
Cheng, Rita Wai Ting	Habib/Ronskey	Phalke, Santosh Madhuka	Couloigner
Chiu, Wenya	Couloigner	Pullivelli, Anoop Manohar	Habib
Crawford, Scott	Cannon	Qiu, Jianning	Lachapelle
Dao, Diep Thi Hong	Lachapelle	Richert, Todd	El-Sheimy
de Groot, Lance	Skone	Ried, Matthew	Barry
Deshpande, Sameet	Cannon	Salycheva, Anastasia	Cannon
Devaraju, Balaji	Sneeuw	Sharma, Jayanti	Collins
Dharmaraj, Girija	Mioc/Habib	Sharma, Ojaswa	Mioc/Habib
Encinas, Leonardo Soliz	Lachapelle	Sheng, Li (Tony)	Tait/Cannon
Godha, Saurabh	Cannon	Singh, Sanjeet	Klukas/Cannon
Goodall, Christopher L.	El-Sheimy	Srinivas, Shyam Suresh	Lachapelle
Guo, Libing	Huang/Blais	Trevis, Landra	El-Sheimy
Hou, Haiying	El-Sheimy	Tsoi, Raymond	Sneeuw/Cannon
Hoyle, Victoria Anne	Skone	van der Wal, Wouter	Sideris
Hu, Tao	L a c h a p e l l e / Klukas	Wang, Min	Lachapelle
Jiang, Zhi	Lachapelle	Watson, John	Lachapelle/Klukas
Karunanayake, M. Dhar	C a n n o n / Lachapelle	Wojciechowski, Adam	Gao
Kim, Nyunook	Lachapelle	Wright, Bruce	El-Sheimy
Kopp, Eric	Collins	Wu, Qiang	Huang
Lee, Suen	Gao	Wu, Sally Xia	Habib
Lian, Ping	Lachapelle	Xie, Chenlin	Huang
Lin, Min Min	L a c h a p e l l e / O'Keefe	Xing, Xitao	Cannon
Mao, Li Man	Rakai	Yao, Donghua	Lachapelle
McAllister, David Michael	Valeo	Yu, Wei	Lachapelle
Meenakshisundaram, Valarmathy	Couloigner	Zhang, Hai Tao	Cannon
MEng Students			
Huang, Andrew	Cannon	Kubacki, Wojciech	Cannon/Skone
Kaplo, Abboud	Mioc		

Part – time Graduate Students 2004/2005				
Name	MEng	MSc	PhD	Supervisor
Angelo, Joseph	1			Lachapelle/Cannon
Fox, Ryan J.		1		Teskey/Tait
Gaidadjiev, Radoslav		1		Tait
Galappaththi, Thilanka L.		1		El-Sheimy
Garin, Lionel J. J.			1	Lachapelle
Ip, Alan		1		El-Sheimy
Ketcheson, Kelly	1			Mioc
Syed, Salman		1		Cannon
Yousuf, Ruben		1		Skone
Vance, Kevin L.	1			Lachapelle
Zhang, Huasiu (Larry)		1		Blais/Collins
Total	3	7	1	



Survey Camp 2004



GRADUATE STUDIES CONVOCANTS 2004/05					
Name	Degree	Exam Date	Graduate Thesis Title	Supervisor	
Michel Fawzy Morgan	Morgan	PhD	May 03, 2004	Epipolar Resampling of Linear Array Scanner Scenes	A. Habib
Mudiyanselage Chaminda	Basnayake	Ph.D.	June 03, 2004	Automated Traffic Incident Detection Using GPS Based Transit Probe Vehicles	G. Lachapelle/ A. MacIver
Joseph John	Angelo	MEng	June 04, 2004	Course-based	G. Lachapelle/M. E. Cannon
David Bruce	Wright	MSc	June 07, 2004	The Development of a Real Time Forest Fire Hot Spot Detection and Georeferencing System	N. El-Sheimy
Sameet Mangesh	Deshpande	MSc	July 05, 2004	Study of GPS Signal Acquisition and Radio Frequency Interference Effects on GPS Signal Acquisition	M. E. Cannon
Anastassia	Salytcheva	MSc	September 01, 2004	Medium Accuracy INS/GPS Integration in Various GPS Environments	M. E. Cannon
Haiying	Hou	MSc	September 10, 2004	Modeling Inertial Sensors Errors Using Allan Variance	N. El-Sheimy
Suen Man	Lee	MSc	September 28, 2004	A Software Engine for the Rapid Development of Mobile Asset Management Systems	Y. Gao
Zhi	Jiang	MSc	September 29, 2004	Mitigation of Narrow Band Interference on Software Receivers Based on Spectrum Analysis	G. Lachapelle
Jayanti	Sharma	MSc	October 04, 2004	The Influence of Target Acceleration on Dual-Channel SAR-GMTI (Synthetic Aperture Radar Ground Moving Target Indication) Data	M. J. Collins
Paulo Roberto S.	Alves	PhD	October 20, 2004	Development of Two Novel Carrier Phase-Based Methods for Multiple Reference Station Positioning	G. Lachapelle/ M.E. Cannon
Kai-Wei	Chiang	PhD	November 19, 2004	INS/GPS Integration Using Neural Networks for Navigation Applications	N. El-Sheimy
Alan Wing Lun	Ip	MSc	November 29, 2004	Analysis of Integrated Sensor Orientation for Airborne Mapping	N. El-Sheimy
Ping	Lian	MSc	December 20, 2004	Improving Tracking Performance of PLL in High Dynamic Applications	G. Lachapelle
Walid M. Nour-Eldin	Abdel-Hamid	PhD	December 20, 2004	Accuracy Enhancement of Integrated MEMS-IIMU/GPS Systems for Land Vehicular Navigation Applications	N. El-Sheimy/ G. Lachapelle
Victoria A.	Hoyle	MSc	December 20, 2004	Augmentations to a Ground-Based GPS Network for Improved 4_D Tropospheric Water Vapour Tomography	S. Skone
Yong Won	Ahn	MSc	Jan 14, 2005	Analysis of NGS CORS Network for GPS RTK Performance Using External NOAA Tropospheric Corrections Integrated with a Multiple Reference Station Approach	G. Lachapelle/ S. Skone
Landra Karolyi	Trevis	MSc	January 21, 2005	Prototype Development for a Wildfire Modeling and Management System	N. El-Sheimy
Shin	Eun Hwan	PhD	February 22, 2005	Estimation Techniques for Low Cost Inertial Navigation	N. El-Sheimy
Oleg Alexander	Mezentsev	PhD	March 03, 2005	Sensor Aiding of HSGPS Pedestrian Navigation	G. Lachapelle
Scott Alan	Crawford	MSc	March 03, 2005	Performance Evaluation of Sensor Combinations for Mobile Platoon Control	M. E. Cannon
Anoop Manohar	Pullivelli	MSc	March 22, 2005	Low-Cost Digital Cameras: Calibration, Stability Analysis and Applications	A. Habib
Todd A.	Richert	MSc	April 12, 2005	The Impact of Future Global Navigation Satellite Systems on Precise Carrier Phase Positioning	N. El-Sheimy
Diep Thi Hong	Dao	MSc	April 15, 2005	Performance Evaluation of Multiple Reference Station GPS RTK for a Medium Scale Network	G. Lachapelle
Kongzhe	Chen	PhD	April 18, 2005	Real-Time Precise Point Positioning, Timing and Atmospheric Sensing	Y. Gao
Bijoy	Paul	MSc	April 20, 2005	Hidden Point Bar Method for High-Precision Industrial Surveys	B. Teskey
John Robert Alexander	Watson	MSc	April 25, 2005	High-Sensitivity GPS L1 Signal Analysis for Indoor Channel Modelling	G. Lachapelle/R. Klukas

GRADUATE STUDENT SEMINARS—2004/05

SPEAKER	TOPIC
Tao Hu	Indoor GPS Signal Replication By Using Spirent GSS6560 GPS Simulator
Andrew Hunter	Animal Movement Analysis: Matching Behaviour with Scale
Ruben Yousuf	Enhancement of the Wide Area Augmentation System (WAAS) by Using a Refined Ionospheric Model
Minmin Lin	RTCM 3.0 Implementation in RTK Network
Olivier Julien	Impact of Future GNSS Signal Modulations on Carrier-Phase / Frequency Tracking
Girija Dharmaraj	Algorithms for Raster-Vector Conversion of Scanned Maps
Bijoy Paul	Hidden Point Bar Method for High-Precision Industrial Surveys
David McAllister	Remote Estimation of Leaf Area Index
Valarmathy Meenakshisundaram	Image Fusion Of High Resolution Pan And MS Images For Urban Mapping
Mohamed Abdel-Salam	Some Aspects of Precise Point Positioning
Rob Watson	High-Sensitivity Analysis of Raw GPS L1 Data for Indoor Channel Modelling
Anoop Pullivelli	Low-Cost Digital Cameras: Calibration, Stability Analysis and Applications
Santosh Phalke	Change Detection Of Linear Man-Made Objects Using Feature Extraction Technique
Liman Mao	Web-based Information System for Aboriginal Land Management
Haitao Zhang	Performance Comparison of Kinematic GPS Integrated with Different Tactical Level IMUs
Diep Dao	Performance Evaluation of Multiple Reference Station GPS RTK for Medium and Small Scaled Networks
Oleg Mezentsev	Sensor Aiding of HSGPS Pedestrian Navigation
Cameron Ellum	Integration Of Raw GPS Measurements Into A Photogrammetric Bundle Adjustment
Alan Ip	Performance Analysis of Intergrated Sensor Orientation
Eun-Hwan Shin	Backward Unscented Kalman Filter and Smoother for Low-Cost Intertial Surveying
Rebeca Quinonez-Pinon	Estimating Evapotranspiration From Remote Sensing And Vegetation Morphology
Kongzhe Chen	Real-Time Positioning, Timing and Atmosphere Sensing with Un-differenced Data
Yong Won Ahn	Analysis of NGS-CORS Network for RTK Positioning Using External NOAA Tropospheric Corrections Integrated with a Multiple Reference Station Approach
Natalya Nicholson	Tropospheric Tomography Models for a Regional GPS Network
Dhar Karunanayake	Hardware Simulator Evaluation of Assisted GPS
Scott Crawford	Performance Evaluation of Sensor Combinations on Mobile Robots for Automated Platoon Control

GRADUATE STUDENT SEMINARS—2004/05, continued

SPEAKER	TOPIC
Sanjeet Singh	Performance Evaluation of AGPS and High Sensitivity Receivers in Weak Signal Environments
James Wang	Fuzzy Logic Expert Rule-based Multi-Sensor Data Fusion for Land Vehicle Attitude Estimation
Ping Lian	Improving Tracking Performance of PLL in High Dynamics Applications
Bo Zheng	Acquisition Schemes for a GPS L5 Software Receiver
Walid Abdel Hamid	Towards a Reliable MEMS-based INS/DGPS Integrated System for land-vehicular Navigation Applications
Landra Trevis	The Development Of An Internet GIS System For Real-Time Wildfire Behavior Modeling And Monitoring
Larry Zhang	Automatic Extraction of GIS Features from Multispectral Imagery through a Combination of Spectral and Spatial Information, and Its Application to Forest Stands
Todd Richert	The Impact of Future Global Navigation Satellite Systems on Precise Carrier Phase Positioning
Kai Wei Chiang	Improving the Positioning Accuracy of DGPS/MEMS IMU Integrated Systems Utilizing Cascade De-noising Algorithm
KongZhe Chen	Real-Time Positioning, Timing and Tropospheric Delay Estimation with Undifferenced Data
Syed Salman	Development of GPS Based Map Aided Vehicle Navigation Algorithms
Anastasia Salycheva	Medium Accuracy INS/GPS Integration for Open Areas and Downtown Canyons
Jennifer Whittal	A Framework for Analysis of Fiscal Cadastral Reform
Zhi Jiang	Mitigation of Narrow Band Interference on Software Receivers based on Spectrum Analysis
Jayanti Sharma	The Influence of Acceleration on Detection, Velocity Estimation, and Focusing of Moving Targets in Dual-Channel SAR



Professor G. Lachapelle with former ENGO student Dr. Rami Al-Ruzouq, now a faculty member in the Dept of Geomatics Engineering, Al-Balqa' Applied University, Jordan, at Umm Qays, an ancient Roman city in Northern Jordan, January 2005

GRADUATE SPECIALIZATION AREAS AND COURSES

Gravity Field and Geodynamics	Positioning, Navigation and Wireless Location	Digital Imaging Systems	Engineering Metrology	GIS and Land Studies
ENGO 615 Advanced Physical Geodesy	ENGO 623 Inertial Surveying and Ins/GPS Integration	ENGO 623 Inertial Surveying and Ins/GPS Integration	ENGO 629 Least Squares Estimation and Analysis	ENGO 661 Advanced Spatial Information Systems
ENGO 629 Least Squares Estimation and Analysis	ENGO 625 Navstar GPS: Theory and Applications	ENGO 629 Least Squares Estimation and Analysis	ENGO 667 Advanced Topics in Photogrammetry	ENGO 665 Advanced Survey Law
ENGO 663 Satellite Altimetry And Applications	ENGO 629 Least Squares Estimation and Analysis	ENGO 639 Digital Stereo Image Processing		ENGO 667 Advanced Topics in Photogrammetry
ENGO 681 Global Geophysics and Geodynamics	ENGO 633 Atmospheric Effects on Satellite Navigation System	ENGO 661 Advanced Spatial Information Systems		ENGO 699.51 Advanced Land Use Planning
	ENGO 699.57 Advanced Topics in GPS	ENGO 667 Advanced Topics in Photogrammetry		



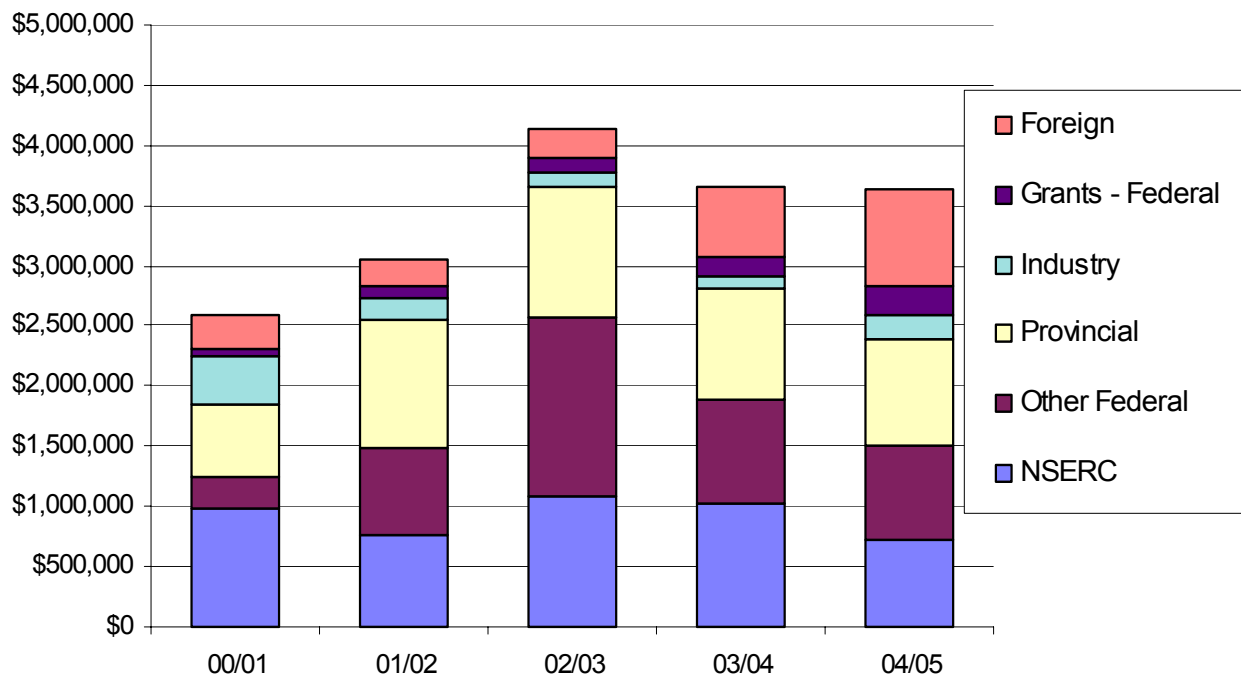
M.Sc Defense of Haiying Hou
 Back Row (L to R): Dr. Abraham Fapojuwo, Dr. Shelley Lissell, Dr. Yang Gao
 Front Row (L to R): Dr. Naser El-Sheimy, Haiying Hou

RESEARCH

Research Statistics

Research is an integral part of Department activities. It allows individual faculty members to stay at the leading edge of their area of specialization and to apply their knowledge to current problems in industry and government. It also provides funding for research associates and graduate students. It thus supports the education of highly trained future engineers and the teaching activities of the Department.

Direct research funding for this report year was at \$3,643,589 which was approximately \$192,000 per faculty member, based on 19 faculty members. This continues to be an excellent level of support.



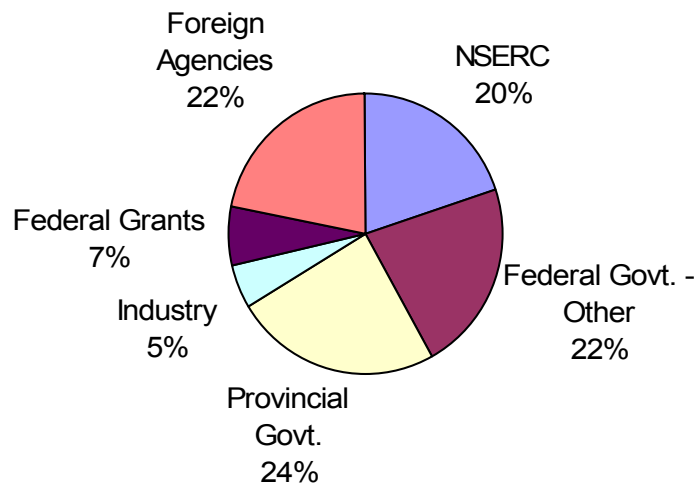
Direct Research Funding by Source—2000/01 to 2004/05

**Research Grants and Contracts for the Period
April 1, 2004 – March 31, 2005**

Source	Amount
NSERC	\$722,075
Federal Government—Other	790,431
Federal – Grants	242,436
Provincial Government	876,782
Industry	202,627
Foreign Agencies	809,238
Direct Research Support	\$3,643,589
Research Scholarships	248,586
Equipment Donations	60,978
Other Research Support	\$309,564
Total Research Support	\$3,953,153

In addition to direct research funding, there is other research support available in terms of student scholarships, and in-kind donations. When added to the direct project funding, the total research for the reporting period is increased to \$3,953.153.

The figure on the previous page shows direct research funding for the last five years and the one below shows the research funding by source for 2004/2005.



Direct Research Funding by Source—2004/05

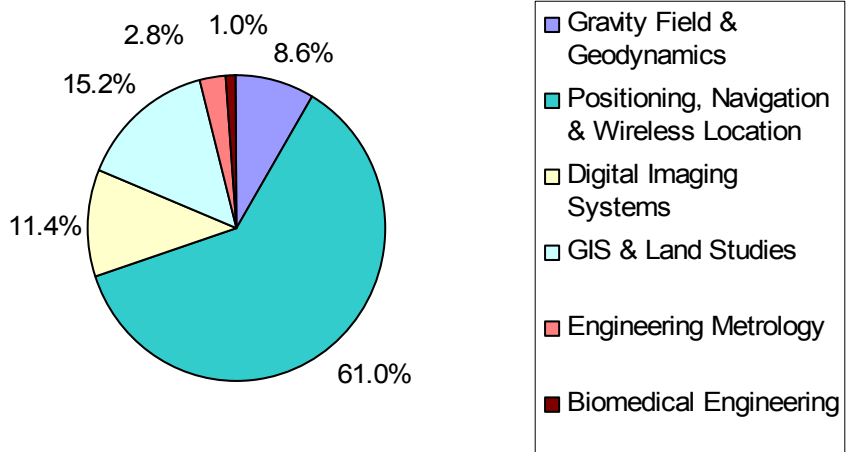
Major Research Areas

Gravity Field and Geodynamics
A. Braun, M.G. Sideris, N.J. Sneeuw
GIS and Land Studies
M.B. Barry, N. El-Sheimy, B. Huang, D. Mioc, M.E. Rakai, C. Valeo
Digital Imaging Systems
M.J. Collins, I. Couloigner, A.F. Habib
Positioning, Navigation and Wireless Location
M.E. Cannon, N. El-Sheimy, Y. Gao, G. Lachapelle, K. O'Keefe, S.H. Skone
Engineering Metrology
M.P. Tait, W.F. Teskey

Research projects being conducted in the above major research areas are listed in tables on pages 40 to 44.

The number of graduate students working in each area is indicated in the adjacent figure.

Some factors in the distribution of students are: the number of faculty members per research area, and the number of new faculty members in the department that are currently in the early stages of recruiting students and building their research groups. The distribution confirms that each of the research areas in the Department is viable in terms of faculty and graduate student involvement and has the depth in human resources



Percentage of Graduate Students in Each Research Area

Projects in Positioning, Navigation and Wireless Location		
Project Name	Contract Type	Faculty Investigators
ASW-GPS and Ionospheric R&D Support	Foreign	S.H. Skone M.E. Cannon G. Lachapelle
Algorithms for Tubing Drilling	Industry	G. Lachapelle
Analysis of GNSS Signal Performance & Algorithm Development	Federal	M.E. Cannon
Assess and Compare the performance of HSGPS receivers and A-GPS Solutions	Industry	Y. Gao
Assessment of GPS Technologies in Agriculture	Industry	G. Lachapelle
Carrier Phase Based Global Differential GPS Positioning	NSERC	Y. Gao
Chair, CRC in Wireless Location	Federal/CRC Program	G. Lachapelle
Chair, CRC in Mobile Multi-Sensor Geomatics Systems	Federal/CRC Program	N. El-Sheimy
CRC - Faculty Support	Provincial	N. El-Sheimy
CRC Market Supplement	Provincial	N. El-Sheimy
Collaborative Driving System	Federal	M.E. Cannon
Construction of an Integrated Navigation Information System	Federal	M.E. Cannon
Design and Development of a Precise GPS/INS Vehicle Positioning System Part 1	Foreign	M.E. Cannon G. Lachapelle
Design and Implementation of a GPS/WAAS/eLoran Positioning System	Industry	G. Lachapelle M.E. Cannon
Development of Next Generation MEMS-based Surveying System for Drilling Operation	Provincial	N. El-Sheimy
Development of MEMS-Based Survey System for Drilling Applications	Industry	N. El-Sheimy
Development of a Platform for Rapid Development of Mobile Asset Management Systems	Federal	Y. Gao
Development of a Real-Time Mobile Mapping System for Forest Fire Fighting	NSERC	N. El-Sheimy
GEOIDE NCE - Development of Point-RTK Technology	NSERC	Y. Gao
GEOIDE NCE - Development of INS/GPS Integration Software Using Artificial Neural Network of Wavelet & Multi-Resolution Analysis	Federal	N. El-Sheimy
GEOIDE NCE - GNSS Signal Tracking Performance	Federal	G. Lachapelle
GEOIDE NCE - Next Generation MEMS-based Navigation System for Vehicles and Personal Location Navigation	Federal/NSERC	N. El-Sheimy Y. Gao
Faculty of Engineering/Dept. Starter Grant	Provincial	K. O'Keefe
iCORE Chair in Wireless Location	Provincial	G. Lachapelle
Ionosphere Modelling	NSERC	S.H. Skone

Positioning, Navigation and Wireless Location (continued)

Project Name	Contract Type	Faculty Investigators
Impact of a Wind Turbine Installation Close to DGPS Station Hartlen Point (DGPS Accuracy Impact)	Federal	S.H. Skone
Intelligent Shovel Excavation	Provincial	Y. Gao
Investigation of DGPS Positioning Accuracies in Canada for Ionospheric Storm Events	Federal	S.H. Skone
Joint Precision Approach and Landing System (JPALS) Phase II	Foreign	G. Lachapelle M.E. Cannon
MEMS Based Inertial Systems for Vehicle Navigation Applications	NSERC Strategic	N. El-Sheimy Y. Gao G. Lachapelle
Mobile Telephone Location	Foreign	G. Lachapelle
Multi-Sensor Geomatics Systems	Federal	N. El-Sheimy
Multi-Sensor Systems	Provincial	N. El-Sheimy
NCE Auto 21 Network	Federal	G. Lachapelle
Observation and Modelling of Radio-Frequency Propagation for Improved Wireless Location in Urban and Indoor Environments	Provincial	K. O'Keefe
Observation of Radio-Frequency Multipath in Urban and Indoor Environments	Federal	K. O'Keefe
Performance Analysis of Multiple Global Navigation Satellite Systems	NSERC	G. Lachapelle
Point RTK	Federal	Y. Gao
Point RTK Development Systems	NSERC	Y. Gao
RTK and Regional Network Calibration	Industry	G. Lachapelle
Regional Area GPS Kinematic Positioning Using Multiple Reference Stations	NSERC	M.E. Cannon
Regional Real-Time Water Vapour Estimation Using GPS	Federal	S.H. Skone M.E. Cannon G. Lachapelle
Signal Tracking and Measurement Infrastructure to Support Wireless Location and Communications Research	Federal	M.E. Cannon G. Lachapelle
Steacie Research Funding	NSERC	M.E. Cannon
Study on the Impact of Range Rate Corrections (RCC) on DGPS Accuracy	Federal	S.H. Skone
Tactical Outdoor Positioning System (TOPS) Technology Demonstrator	Federal	G. Lachapelle J. Nielsen (ENEL)
Testing NovAtel BDS GPS/INS System	Industry	N. El-Sheimy
Terramatics Systems Accuracy Assessment	Industry	N. El-Sheimy
Travel Grant to European Navigation Conference 2004	Provincial	S.H. Skone

Projects in Engineering Metrology

Project Name	Contract Type	Faculty Investigators
Hidden Point Bar	Industry	W.F. Teskey
Monitoring Permafrost Deformation in the Mackenzie Delta	Industry	M. Tait
Monitoring deformation in permafrost	NSERC	M. Tait

Projects in Gravity Field and Geodynamics

Project Name	Contract Type	Faculty Investigators
Development of a Dynamic, Seamless, Vertical Reference System	Federal	M.G Sideris
Development of a Dynamic, Seamless, Vertical Reference Systems for Geomatics Applications - GEOIDE NCE	NSERC	M.G Sideris N.J. Sneeuw
Faculty Starter Grant	Provincial	A. Braun
Future Gravity Field Satellite Missions	Foreign	N.J. Sneeuw
Global Gravity Field Determination from Dedicated Satellite Missions	NSERC	N.J. Sneeuw
Multiresolution Approximation of the Earth's Gravity Field	NSERC	M.G Sideris
Monitoring Sea Level Changes in Coastal Regions Using GPS and Other Space-based and Terrestrial Techniques	Provincial	M.G Sideris
Quantification of Sea Ice Thickness and Surface Water Levels in the Arctic Ocean and Canada Using Satellite Altimetry	Federal	A. Braun
Space Gravimetry Contributions to Earth Monitoring - NCE GEOIDE	Federal	A. Braun
Optimal Combination of Terrestrial and Altimetric Data with Data from the New Satellite Missions of CHAMP and GOCE for the Accurate Determination of the Gravity Field	Foreign	M.G Sideris

Projects in GIS and Land Studies		
Project Name	Contract Type	Faculty Investigators
CRC in Mobile Multi-sensor Geomatics Systems	NSERC/Federal	N. El-Sheimy
Data Structure and Algorithms for Raster/Vector GIS Integration	Provincial	D. Mioc
Data Structures and Algorithms for the Integration of Raster and vector GIS	NSERC	D. Mioc
Design and Implementation of a Preliminary Multi-Dimensional GIS	Provincial	B. Huang
Disturbance Modelling in Forested Watersheds	Provincial	C. Valeo
Dept/Faculty of Engineering Starter Grant	Provincial	B. Huang
Faculty of Engineering Starter Grant	Provincial	M. Barry
Faculty of Engineering Starter Grant	Provincial	D. Mioc
Fundamental Hydrologic Landscape Units	Provincial	C. Valeo
Grizzly Bear Tracking Collar	Provincial	N. El-Sheimy
Integrating Real Time Mass Loading and Microbial Source Tracking into River Water Quality Assessment	Provincial	C. Valeo
Mathematical Models to Estimate Residential Land Values	Provincial	M. Barry
Multi-Sensor Geomatics Systems	Federal	N. El-Sheimy
Multi-Sensor Systems	Provincial	N. El-Sheimy
Real-time Airborne Mapping System	NSERC	N. El-Sheimy
Physical Based Modelling of Urbanizing Catchments under Multi-Seasonal Conditions	NSERC	C. Valeo
Reducing the Vulnerability of Water Supply Under a Changing Climate: An Assessment of Stormwater Reuse Measures	Federal/Provincial	C. Valeo
Talking Titler	NSERC	M. Barry
Talking Titler in Creating Land Records	Federal	M. Barry
Web-Based Knowledge Information Systems for Aboriginal Land Management	Provincial	M. Rakai

Projects in Digital Imaging Systems		
Project Name	Contract Type	Faculty Investigators
Automating 3D feature extraction and change detection - NCE Geoide	Federal	I. Couloigner
Automatic Registration of Multi-Source Imagery	Provincial	A. Habib
Camera Calibration and Stability Analysis, Software Specifications	Industry	A. Habib
Co-Registration of Photogrammetric & LIDAR Surfaces for Evaluation & Validation of the Systems Calibration - NCE Geoide	Federal	A. Habib
DolSAR and InSAR Analysis	Federal	M.J. Collins
Geometric Rectification of Declassified Intelligence Satellite Photographs (DISP)	NSERC	A. Habib
Hyperspectral Applications for Renewable and Mineral Resources - GEOIDE NCE	Federal	M.J. Collins
Investigation into Geometric Fusion of Satellite Based Images for 3-D Object Reconstruction	Foreign	A. Habib
Man-made Features Extraction from High Resolution Imagery in Urban Areas	NSERC	I. Couloigner
Remote Sensing Eval. and Assess. of Optimum Acid Gas Flaring Conditions to Balance and Minimize SO ₂ and CO ₂ Emmissions	Industry	I. Couloigner
Research Support to Radarsat DND	Federal	M.J. Collins
Skeleton Design for the Development of Multi-sensor and Multi-primitive Triangulation System	Provincial	A. Habib
The Development of M2G - A Mobile Multi-Sensor Geomatics Systems - GEOIDE NCE	Federal	A. Habib
Travel Grant: Symposium on Remote Sensing	Provincial	I. Couloigner
Uncertainty Management of Remote Sensing Based Environmental Modelling	NSERC	M.J. Collins

PUBLICATIONS

Books and Chapters

- Han, S.-C., C.K. Shum, C. Jekeli, A. Braun, Y. Chen, C. Kuo, (2004), CHAMP Gravity Field Solutions and Geophysical Constraint Studies, pp 108-114, In: Earth Observation with CHAMP: Results from Three Years in Orbit, Ch. Reigber, H. Luehr, P. Schwintzer, J. Wickert (Eds.), 628 p, Geoscience Series, Springer-Verlag, Berlin, Heidelberg
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- Zhang, Q., I. Couloigner, (2005) A new and efficient k-medoid algorithm for spatial clustering, Lecture Notes in Computer Science 3482, 3-540-25862-0, pp. 181 – 189.

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- Abd-Elhamid, W., A. Osman, A. Noureldin, N. El-Sheimy, (2005) Wavelet Multi-Resolution Analysis for Enhancing the Performance of Integrated GPS and MEMS-Based Navigation Systems, **Geomatica**, **59(1)**, pp. 297-305.
- Alves, P, G. Lachapelle and M.E. Cannon (2005) Collocation-based Multiple Reference Station DGPS RTK Positioning. **Geomatica**, **59(1)**, pp. 37-47.
- Bajracharya, S., and M.G. Sideris, (2004) The Rudzki inversion gravimetric reduction scheme in geoid determination, **Journal of Geodesy**, **78**, pp. 272-282
- Bajracharya, S. and M.G. Sideris. (2005). Density and gravity interpolation effects on Helmert geoid determination. **Geodesy and Cartography** **54(2)**
- Bajracharya, S. and M.G. Sideris. (2005). Terrain-aliasing effects on gravimetric geoid determination. **Geodesy and Cartography** **54(1)** pp. 3-16.
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- Cannon, M.E., T. McCarron, J.L. Lupart, (2004) Description and Evaluation of the SCiberMENTOR Email Mentoring **Program for Girls, Alberta Gifted and Talented Education Journal**, **17(1)**, pp19-28
- Chiang, K.W., A. Noureldin, and N. El-Sheimy, (2004) A New Weights Updating Method for Neural Networks Based INS/GPS Integration Architectures, **Journal of Measurement Science and Technology**, **15(10)**, pp. 2053-2061.
- Chiang, K.W., and N. El-Sheimy, (2004) Artificial Neural Networks in Direct Georeferencing: Performance Analysis, **Journal of Photogrammetric Engineering and Remote Sensing**, **70(7)** pp. 765-768.
- Chiu W.Y., and I. Couloigner, (2004) Evaluation of Incorporating Texture into Wetland Mapping from Multispectral Images, **EARS eL eProceedings**, **3(3)**, pp. 363-371.

- Collins, M.J., C. Dymond, E.A. Johnson, (2004) Mapping Subalpine Forest Types using Networks of Nearest Neighbour Classifiers., **International Journal of Remote Sensing**, **25(9)** pp. 1701-1721
- Collins, M.J., M.A. de Jong, (2004) Neuralizing target super-resolution algorithms, **IEEE Geoscience and Remote Sensing Letters**, **1(4)**, pp. 318-321
- Dao, D., P. Alves and G. Lachapelle (2004) Performance Evaluation of Multiple Reference Station GPS RTK for a Medium Scaled Network. **Journal of Global Positioning Systems**, Vol. 3, 1-2, 173-182.
- Dogan, U., P. Alves, G. Lachapelle, and S. Ergintav, (2004) Testing a Multiple Reference Station GPS Network for Real-Time Carrier Phase-Based Positioning in the Marmara Region, Turkey, **Survey Review**, **37(293)**, pp. 568-576.
- El-Sheimy, N., K.W. Chiang, X. Niu, and A. Noureldin, (2004), Performance Analysis of GPS/MEMS based IMU Data Fusion Utilizing Artificial Neural Networks, **European Journal of Navigation**, **2(4)** pp. 2-11.
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- El-Sheimy, N., S. Nassar, and A. Noureldin, (2004) Wavelet De-noising for Fast and Accurate Alignment of Inertial Measurement Units, **IEEE Aerospace and Electronic Systems**, **19(10)**, pp 32-39.
- El-Sheimy, N. and Wright, B. (2005) The Development and Testing of a Prototype Mobile Mapping System for Real-time Forest Fire Hot Spot Detection, **Photogrammetric Engineering & Remote Sensing** **71(4)** April, pp. 461-470.
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- Gruber, C., D Tsoulis, and N Sneeuw, (2005) CHAMP Accelerometer Calibration by Means of the Equation of Motion and an A-Priori Gravity Model, *zfv – Zeitschrift für Geodäsie, Geoinformation und Landmanagement*, 130(2):92-98
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- Habib, A., (2005), Mobile Mapping Systems: Current Challenges, **GIS Development (Middle East)**, 1(1), pp. 42-45.
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- Huang, B., S.Z. Yi, and W.T. Chan, (2004), Spatio-Temporal Information Integration in XML, **Future Generation Computer Systems**, 20(7), pp. 1157-1170.
- Huang, B., T.F. Fwa, and W.T. Chan, (2004) Pavement Distress Data Collection Based on Mobile GIS, **Transportation Research Record**, 1889, pp. 54-62.
- Hunter, A. and N. El-Sheimy, (2004), Mobile GIS and Speech Recognition, **Photogrammetric Engineering & Remote Sensing**, 70(7), pp. 581-591.
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