DEPARTMENT OF GEOMATICS ENGINEERING

PROGRESS REPORT 2002/03

UNIVERSITY OF CALGARY

GEOMATICS ENGINEERING

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Number 50034

PROGRESS REPORT
2002/2003

DEPARTMENT OF
GEOMATICS ENGINEERING

Faculty of Engineering

May 2003

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Cover Photo: *The world-class Global Navigation Satellite System (GNSS) Navigation Laboratory and its associated Rooftop Antenna Range together form one of the true gems of the Intelligent Technologies group of specialized research facilities within the CCIT. Direct antenna connections from the Navigation Lab to the Rooftop Antenna Range greatly facilitate research on satellite-based RF signals (such as GPS) for navigation and position location and permit accurate and repeatable multi-antenna testing*
Photo by: Aaron Morton

Admitted to the Degree of
BACHELOR OF SCIENCE

Ryan Curtis Audette (With Distinction) (Internship)
Adam James Barvir (Internship)
Terry Dean Beblow
Jeffery Wayne Blatz
Scott Garon Boulanger (With Distinction)
Ryan Patrick Burke (Internship)
Magdalena Bytnar (Internship)
Rita Wai Ting Cheng (With Distinction) (Internship)
Barry Donald Clement (Internship)
Gordon John Copithorne (With Distinction) (Internship)
Tyler John Fox
Benjamin Lane Hocker
Jeremy David Howden
Jaime Lin Poa Jee (Internship)
Daniel Jacob Kalmanovitch
Cheryl Ngai Man Kwan (Internship)
Daniel Richard Langen (Internship)
Douglas Raymond Langen (With Distinction) (Internship)
Melissa Yuen Kay Lee (With Distinction) (Internship)
David Cameron MacDonald (With Distinction) (Internship)
Kevin Joseph Magowan (Internship)
David Michael McAllister (Internship)
Kevin James Nemrava
Jonathan Paul Neufeld
Davinder Singh Parmar
Anoop Manohar Pullivelli (Internship)
Jacek Remigjusz Pyc
Kiarash Shayestehfar
Amy Simmons (With Distinction) (Internship)
Leannah Shivanie Sinanan (Internship)
Sawsan Temraz
Chun Yeung Tsar
Chi Fu Tse (Internship)
Raymond Tsoi
Matthew Michael Vanderwey
Rachel Sylviane Vincendeau
Craig Andrew White
Adam Christopher Wojciechowski (With Distinction) (Internship)
Johnny Ho-Yen Wong
Chang-bae Yoon
Kin Yan Wong
Ruben Yousuf (Internship)

Admitted to the Degree of
MASTER OF ENGINEERING

David Alton
Jonathan Auld
Marcia Bates
Yan Lu

Admitted to the Degree of
MASTER OF SCIENCE

Michael de Jong
Mahmoud El-Gizawy
Carrie Ho
Andrew Hunter
Sandra Kennedy
Jungie Liu
Zhe Liu
Kristian Morin
Nadia Shahriari Namini
Michael Olynik
Lynn Raaflaub
Xiaobing Shen

Admitted to the Degree of
DOCTOR OF PHILOSOPHY

Michael Kern
Mark Petovello
Rob Radovanovic
Samuel Ryan

TABLE OF CONTENTS

HIGHLIGHTS 2002/2003

Geomatics Engineering was identified within the Technologies and Information Area of Strength:

The academic plan identifies four areas of strength at the university that we plan to build and for which we expect to be pre-eminent. The development of these four areas will draw on the combined expertise of faculty across the university and foster a multidisciplinary approach to teaching and research. Building these areas of strength and strategically allocating resources to them is essential if the university is to become a national and international leader

... At the U of C, we'll be looking at new methods of processing information effectively and developing new technologies. The university is already recognized as a world leader in geomatics engineering ……

Raising Our Sights
Academic Plan
University of Calgary

This Report covers the period May 2002 to April 2003.

In Spring 2003, 41 students received their BSc degree and 1 in Fall 2002, 4 students their PhD, 12 students their MSc degree and 4 students their MEng. Undergraduate enrolment reached 53, 56 and 48 in each year, in addition to 16 students entered in the Internship Program. Demand for our BSc, MSc and PhD graduands remained exceptionally strong.

The 2002-2003 fiscal period was another very successful year from a research excellence point of view. Faculty members have continued to secure major research funding. The average research funding per faculty member reached 258,982 for the reporting period.

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.

The Department hosted its first **Industry Day** on May 10, 2002. The purpose of Industry Day is to foster more collaboration between our Department and the Geomatics industry in Calgary by making industry more aware of our research activities and expertise.

The Department participated in the formation of the Geomatics Cluster of Calgary. Geomatics was identified appropriately as an emerging cluster, within the C-Prosperity Initiative, based on Calgary's wealth of Geomatics research and application development and number of Geomatics companies. People, representing Geomatics companies and educational and research institutes, developed a number of action initiatives that would further the development of Calgary as a world class Geomatics cluster.

Faculty members Matthew Tait (L) and Caterina Valeo (R) at the Geomatics Engineering display at the G8 summit exhibition

Gerard Lachapelle and representatives from NovAtel at the G8 summit exhibition

Drs. Mike Barry, Ayman Habib, Chris Kotsakis, and **Darka Mioc** joined the Department in Fall 2002. They are introduced later on in this report.

As this is my last year as Head of the Department, I wish to thank all current and departed faculty members, support staff, graduate and undergarduate students who have been consistently supportive of the Department's mission and goals during the eight years of my headship. Without their unconditional support, it would not have been possible to maintain and enhance the Department's truly international reputation of excellence.

Challenges in an academic unit rapidly change and consistency in leadership is a necessity. It is truly a pleasure to introduce the forthcoming interim Head for the period 2003-2004, Dr. Naser El-Sheimy, and Head for the period 2004-2009, Dr. M. Elizabeth Cannon, on the following pages.

Gérard Lachapelle
Professor and Head

Participants in Industry Day

INTERIM AND NEW DEPARTMENT HEADS

DR. NASER EL-SHEIMY, INTERIM HEAD, JULY 2003 – JUNE 2004

Dr. Naser El-Sheimy, Associate Professor and Canada Research Chair in Mobile Multi-sensor Geomatics systems since July 2003, has 19 years of experience in Geomatics Engineering. His research interests include multi-sensor systems, mobile mapping systems, real-time kinematic positioning, and digital photogrammetry and their applications in mapping and Geospatial Information Systems (GIS). Prior to joining the University of Calgary as a faculty member in 1998, Dr. El-Sheimy held the position of VP Research and Development with VISAT Technologies Inc., Montréal. Dr. El-Sheimy leads several research working groups within the International Association of Geodesy and the International Federation of Surveyors. He is the recipient of numerous teaching and research awards and was awarded the annual Department Teaching Excellence Award during each of the last four years.

New Head, Dr. Naser El-Sheimy

DR. M. ELIZABETH CANNON, HEAD, JULY 2004 – JUNE 2009

Dr. Elizabeth Cannon, Fellow of the Canadian Academy of Engineering, joined the Department in 1991 as an NSERC Women's Faculty Awardee. She carries out research and teaching in the area of Global Navigation Satellite Systems (GNSS) and their integration with other positioning and navigation sensors. She has received scores of awards for her work including the U.S. Institute of Navigation Johannes Kepler Award and an NSERC Steacie Fellowship that she is currently holding. From 1997 to 2002, Professor Cannon served as the NSERC/Petro-Canada Chair for Women in Science and Engineering (Prairie Region) during which she worked to promote science and engineering to girls. She also designed innovative programs such as an email mentoring program (SCIberMENTOR), to encourage and retain women in science and engineering-based fields, of which she continues to lead. She will bring significant experience as Department Head through her involvement in numerous scientific, government, corporate and community boards as well as her former position as Special Advisor to the President of the University of Calgary.

MESSAGE FROM THE DEAN

I am very pleased to send a message for the Geomatics Engineering Progress Report. The Geomatics Engineering program, which is unique in Western North America, has given us a leadership position in several key areas such as Navigation and GPS. Our students are sought after across the continent. U of C has chosen Geomatics Engineering as an area of "International Prominence" within the Wireless Communication, Location and Microelectronics cluster. We are very thankful for the strong Federal and Provincial support for geomatics research at Calgary as well as for the encouragement we receive from the 'Geomatics Valley' in Calgary plus the surveying profession. Professor Gerard Lachapelle must be commended for the strong leadership he has given to not only the Department but to the Faculty of Engineering as a whole.

Dr. S. Chan Wirasinghe, Dean
Faculty of Engineering

AWARDS AND RECOGNITION

Graduate students ***Cameron Ellum, Georgia Fotopoulos*** and ***Kyle O'Keefe***, PhD candidates in the Department, have each been awarded an ***Izaak Walton Killam Memorial Scholarship***.

Congratulations to ***Jayanti Sharma*** on receiving a 2002 Julie Payette–NSERC Research Scholarship

Graduate Student ***Michel Morgan*** has been chosen as the recipient of the 2003 Leica Geosystems Internship (formerly the LH Systems Internship). The internship provides the award winner with the opportunity to carry out a small research project of his/her own choice, or to work on an existing LH Systems project as part of a team. In addition, ***Mr. Morgan*** is the recipient of the 2003 ASPRS Space Imaging Award.

Graduate student ***Yong Hu***, PhD candidate, and ***Dr. Vincent Tao***, Adjunct Professor, won the Talbert Abrams Grant Award of the American Imaging and Geospatial Information Society (ASPRS) for their paper *A Comprehensive Study of the Rational Function Model for Photogrammetric Processing*.

Five students won best paper awards:
L. Fortes, *Optimizing the Use of GPS Multi-Reference Stations for Kinematic Positioning*, Institute of Navigation GPS 2002, Portland, OR.
S. Kennedy, *Acceleration Determination from Carrier Phase Measurements*, Institute of Navigation GPS 2002, Portland, OR.
A. Jensen, *Investigations on the Use of Numerical Weather Predictions, Ray Tracing, and Tropospheric Mapping Functions in Relation to Network RTK,* Institute of Navigation GPS 2002, Portland, OR.
G. MacGougan (co-authored by J. Liu), *Fault Detection Methods And Testing For Marine GPS Receivers,* Institute of Navigation GPS 2002, Portland, OR.
S. Nassar, *Different Algorithms for Bridging Kinematic DGPS Outages Using SINS/DGPS Integration,* Institute of Navigation GPS 2002, Portland, OR.

Dr. Naser El-Sheimy received the 2002/2003 Departmental Teaching Excellence Award. ***Naser*** also received the 2003 Geomatics

Engineering Department Professor of the Year (voted by the students) and was nominated for the University of Calgary Students' Union Teaching Excellence Award for 2003.

Dr. Elizabeth Cannon won the first inaugural Minerva Award to celebrate her longstanding efforts in mentoring and mentoring activities. ***Dr. Cannon*** also received the 2002/2003 Departmental Research Excellence Award.

Dr. Michael Sideris was elected as Vice-President of the International Association of Geodesy (IAG) for the period 2003-2007. IAG is a scientific organization in the field of geodesy, which promotes cooperation and research in geodesy on a global scale. It is one of the seven member associations of the IUGG, which itself is a member of the International Council for Scientific Unions (ICSU).

Dr. Gérard Lachapelle was elected Western Region Vice President of the Institute of navigation (ION) for the period July 02- June 03.

Dr. Gérard Lachapelle was been elected Fellow of the Royal Society of Canada for the development and dissemination of satellite-based navigation technology in Canada and internationally in the area of satellite-based positioning.

Dr. Lachapelle receiving his honorary degree in Wuhan, China, November 8

Dr. Yang Gao was awarded an international fellowship of $100,000 from Wuhan University. The fellowship was established to support international scholars to spend one to three months annually in the next three years to work on collaborative research projects in the National Engineering Research Center for Satellite Positioning System and the State's Key Laboratory of Ge-

ography, Remote Sensing and Information Engineering at Wuhan University.

Dr. Susan Skone was awarded a two-year renewal of the NSERC University Faculty Award (UFA). The NSERC UFA program allows Canadian universities to appoint promising researchers to tenure-track or tenured positions in science and engineering. Dr. Skone was initially awarded a three-year UFA in 1999.

Dr. Gerard Lachapelle also received an Honorary Professorship from the University of Wuhan, People's Republic of China. In awarding the status of Honorary Professor to Dr. Lachapelle, the University of Wuhan cited his pioneering contributions and numerous outstanding achievements in the area of satellite-based positioning and navigation during the past 25 years. His sustained involvement in graduate education and in related professional and scientific societies was also cited.

Faculty members at the first Department Meeting in September. Back LtoR: Ayman Habib, Michael Sideris, Bill Teskey, Michael Collins, Richard Klukas, Nico Sneeuw, Mike Barry, Matthew Tait, Gerard Lachapelle. Front LtoR: Naser El-Sheimy, Yang Gao, Darka Mioc, Mele Rakai, Elizabeth Cannon, Susan Skone, Isabelle Couloigner, Caterina Valeo

Faculty Members at the Annual Strategic Meeting, Canada Olympic Park, June 2003. Back LtoR: Mele Rakai, Michael Sideris, Susan Skone, Matthew Tait, Bill Teskey, Elizabeth Cannon, Chris Kotsakis, Isabelle Couloigner, Yang Gao, Darka Mioc Seated: LtoR: Nico Sneeuw, Naser El-Sheimy, Mike Barry, Gerard Lachapelle, Michael Collins, Richard Klukas, Caterina Valeo (Missing from the photo: Ayman Habib)

Congratulations to faculty member Matthew Tait who got married in England, July 2002

PERSONNEL

Faculty

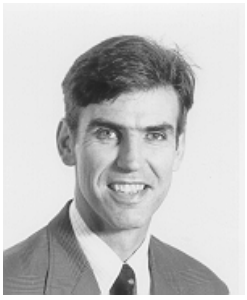
Dr. G. Lachapelle
Professor and Head
CRC/iCORE Chair in Wireless Location
B.Sc., M.Sc., L.Ph., Dr. Techn. (Technical University of Graz), P.Eng., C.L.S., Satellite-based positioning and navigation, wireless location

Dr. N. El-Sheimy
Associate Professor and Associate Head (Undergrad)
B.Sc., M.Sc., Ph.D. (University of Calgary), Multi-sensor systems, real-time mapping and their applications in (GIS).

Dr. S.H. Skone
Assistant Professor and Associate Head (Graduate Studies)
B.Sc., M.Sc., Ph.D. (University of Calgary), Wide-area differential GPS, , atmospheric effects and modelling on satellite navigation.

Dr. M.B. Barry
Assistant Professor
B.Sc., MBA, PhD (Natal)
Cadastral Systems, land tenure and geographic information systems

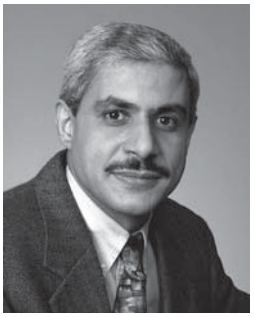
Dr. M.E. Cannon
Professor
B.Sc. (Mathematics), B.Sc., M.Sc., Ph.D. (Killam Scholar, University of Calgary), P.Eng., C.L.S., NSERC Women's Faculty Award, Satellite-based radionavigation systems, precise static and real-time kinematic positioning.



Dr. M.J. Collins
Associate Professor and
Associate Dean (Student Affairs)
B.Sc., M.Sc., Ph.D. (York), Microwave remote sensing, geometric and radiometric analysis of digital images, polar science.

Dr. I. Couloigner
Assistant Professor
Fr. Ing., PhD (trés honorable, Université Nice-Sophia Antipolis/École des Mines de Paris)
Digital image processing, data fusion and wavelet transformation, and high resolution remote sensing imagery.

Dr. Y. Gao
Associate Professor
B.Sc., M.Sc., Ph.D. (University of Calgary), P.Eng.
Robust estimation, satellite positioning and navigation, mobile information management.



Dr. A.F. Habib
Associate Professor
B.Sc., M.Sc., Ph.D. (Ohio State University)
Digital photogrammetry, image processing, image understanding, mobile mapping systems, sensor, data, and information integration.

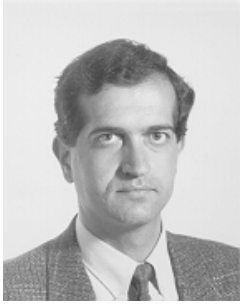
Dr. R.W. Klukas
Assistant Professor
B.Sc., M.Sc., Ph.D. (University of Calgary), P.Eng.
Wireless communicaton and location, signal processing.

Dr. C. Kotsakis
Assistant Professor
Dipl.Ing (Honours), Ph.D. (University of Calgary) Estimation methods in geomatics, gravity field modelling, geodetic reference systems.

Dr. D. Mioc
Assistant Professor
Dip.Eng., M.Sc., PhD (Laval)
Geospatial information systems, computational geometry, spatio-temporal databases .

Ms. M.E. Rakai
Assistant Professor
R.Surv. M.Surv.S.c. (Melbourne)
Land tenure, land information systems, cross-cultural land tenure systems.

Dr. M.G. Sideris
Professor and Associate Dean (Research and International)
Dipl.Ing. (Honours); M.S.c, Ph.D. (The University of Calgary) Geodesy, optimization in geomatics, spectral analysis, gravity field approximation.



Dr. N.J. Sneeuw
Assistant Professor
ir, Dr.-Ing. (Technical University Munich)
Geodesy, gravity field modelling, satellite geodesy, gravity field satellite missions

Dr. M.P. Tait
Assistant Professor
BEng (Hons), Ph.D. (Leeds) Industrial measurement systems and methodologies, closer integration of metrology, 3D modelling.

Dr. W.F. Teskey
Professor
B.Sc. (Distinction; APEGGA Gold Medal), M.Sc., Dr.-Ing. (Stuttgart University), P.Eng., A.L.S., C.L.S. Precise engineering and deformation surveys, integrated anlysis of deformations.

Dr. C. Valeo
Assistant Professor
B.Sc., B.A.Sc., M.Eng., PhD (McMaster), P.Eng., Water resources and environmental engineering, remote sensing and GIS.

Staff Changes

Dr. Mike Barry was appointed to a faculty position in the area of Land Tenure and Geographic Information Science. Dr. Barry holds BSc(Geomatics) and MBA degrees from the University of Cape Town, and a PhD from the University of Natal. He had 10 years experience in private practice and local government prior to joining the Department of Geomatics at the University of Cape Town in 1991, where he was Associate Professor. He has broad working experience in engineering surveying, cadastral surveying, offshore engineering surveying, GIS and project management. He has worked as a surveyor in a number of countries including South Africa, Iraq, Indonesia and Zambia. His research interests include analysing cadastral systems during periods of uncertainty, especially in developing countries, and developing and testing geoinformation technology systems to improve land tenure security. He has published widely internationally and consulted to the Southern African Development Community, the South African Government and the City of Cape Town on GIS education, land tenure, land registration, cadastral surveying and informal settlements. He has received a number of international travel awards and was recently Visiting Professor at the Delft University of Technology in the Netherlands.

Surveying on Land Reform Projects: Cedarbog, South Africa (Mike Barry and his daughter)

New faculty members, from LtoR: Ayman Habib, Mike Barry and Chris Kotsakis

Dr. Ayman Habib was appointed Associate Professor in the area of Digital Photogrammetry. Dr. Habib holds a B.Sc. in Civil Engineering and an M.Sc. in photogrammetry from Cairo University, Egypt. He also obtained a M.Sc. and a Ph. D. in photogrammetry from The Ohio State University. Dr. Habib worked at TransMap Corporation, USA for 18 months as a Senior Photogrammetric Engineer. He joined the Department of Civil and Environmental Engineering and Geodetic Science at The Ohio State University as an assistant professor in 1996. There, he taught and was involved in various research activities in analytical and digital photogrammetry. Dr. Habib's research interests span the fields of terrestrial and aerial mobile mapping systems, modeling the perspective geometry of non-traditional imaging scanners (e.g., line cameras), automatic matching and change detection between various datasets, automatic calibration of low cost/off-the-shelf digital cameras, incorporating analytical and free-form linear features in various photogrammetric orientation procedures, object recognition in imagery, and integrating photogrammetric data with other sensors/datasets (e.g., GPS/INS, GIS databases, multi- and hyper-spectral sensors, and LIDAR). Dr. Habib is also interested in developing cheap photogrammetric systems that would allow non-photogrammetrists to derive precise three-dimensional measurements using off-the-shelf digital cameras. This research aims at linking photogrammetry with other disciplines (e.g., medical, transportation, security, archeological, environmental, and industrial applications).

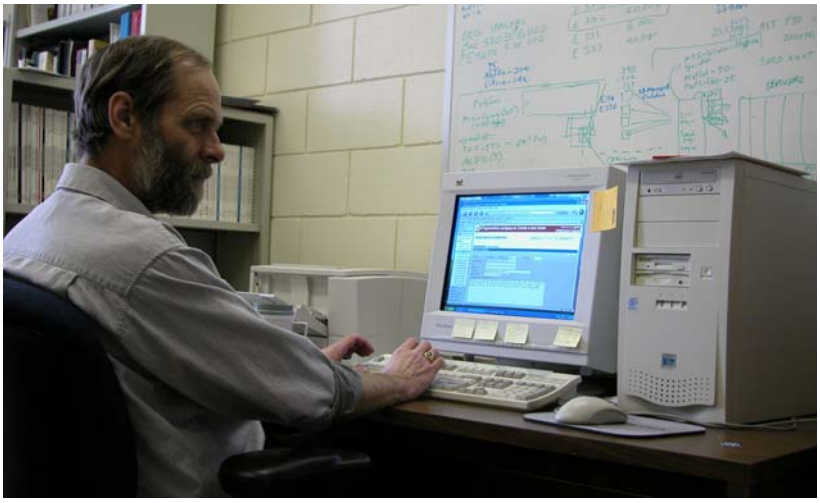
Dr. Darka Mioc was appointed in a faculty position in the area of Geospatial Information Technology. Dr. Mioc holds a Dipl. Eng. in Engineering Geology and Hydrogeology and an M.Sc. in Information Systems from the University of Zagreb (Croatia), and a Ph.D. in Geomatics from Université Laval (Québec City). Dr. Mioc also did post-graduate studies in Geochemistry and Geostatistics at the Joanneum Research Institute (Loeben, Austria). She has been an instructor for various courses given at the University Computing Centre of the University of Zagreb. She has been working on different GIS projects, and has gained working experience in Digital Terrain Models, interpolation, spatial databases, spatial analysis, and environmental modelling. Dr. Mioc was a Post-Doctoral Fellow in the Computational Geometry group at INRIA (Institut National de Recherche en Informatique et en Automatique, France) from 2000 to 2001, where she conducted research in the area of Computational Geometry. Her research interests include data structures and algorithms needed for spatio-temporal change representation, retroactive map updates, map generalizations, and interactive visualization and analysis of spatio-temporal data; and the integration of raster and vector Geographic Information System models. Her areas of expertise include geospatial information systems, geostatistics, computational geometry, spatial databases, and GIS applications for environmental protection.

Dr. Christopher Kotsakis was appointed in a faculty position in the area of Geodesy. Dr. Kotsakis holds a Dipl. Eng. from the Department of Rural and Surveying Engineering at the Aristotle University of Thessaloniki. In 1995, he joined the Department of Geomatics Engineering at the University of Calgary and received his Ph.D. degree in 2000. From 1999–2001 Christopher was also a sessional instructor in our department where he carried on full teaching responsibilities for various undergraduate engineering courses, including gravity field in surveying and geodesy, fundamentals of geodesy, geomatics networks and probability and statistics for engineering. Over the past few years, he has received numerous awards for his excellence in teaching. Upon the completion of his Ph.D. Chris stayed on at the department as a Post-Doctoral Fellow from 2000-2001, where he conducted research work related to gravity field modeling, advanced estimation and approximation methods, and non-probabilistic description of spatial fields using wavelets. Other research interests include estimation theory and inverse problems, Hilbert space

methods for Physical Geodesy boundary value problems, and multiresolution and wavelet methods for gravity field approximation problems. He continues to be a regular reviewer for many scientific journals and conference proceedings series as well as being an active associate member of the IAG since 1997.

Welcome to **Kathy Hamilton** and **Magda Chwialkowska** who joined the technical staff in November.

Techs after a hard day of work



Technical Manager, Garth Wanamaker

Professor Emeritus

Dr. J.A.R. Blais, B.Sc. (Honours; Silver Medal; Hamilton Award), M.A., 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, Dipl. Land Surv., B.Sc. (Honours Roll), M.Sc., (Wild Heerbrugg Award), 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, LL.B., LL.M., 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, Dipl.Ing., M.Sc. 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. Chuck Livingstone
Defence Research and Development Canada

Dr. Shawn Marshall
University of Calgary

Dr. Aboelmagd Noureldin
Royal Military College of Canada

Dr. Oleg Salychev
Moscow Technical University

Dr. Bruno Scherzinger
Applanix Corporation

Dr. Vincent Tao
York University

Support Staff

Administrative

Ms. Marguerite Anderson, Administrative Manager
Mrs. Monica Barbaro, Administrative Secretary
Mrs. Julia Lai**,** Administrative Secretary
Ms. Lu-Anne Markland, Graduate Program Administrator
Ms. Tamara McCarron, B.Sc, Women in Science and Engineering Coordinator and Southern Alberta SCiberMENTOR Program Administrator

Technical

Ms. Magda Chwialkowska, B.Gs, Network Technician Certificate, IT Support Technician
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

Andrew Davison
Digital Imaging Systems/GIS and Land Studies

Carrie Ho
GIS and Land Studies

Jungie Liu
Positioning, Location and Navigation

Quanwei Liu
Gravity Field and Geodynamics

Glenn MacGougan
Positioning, Location and Navigation

Aaron Morton
Positioning, Location and Navigation

Jong UK Park
Positioning, Location and Navigation

Mark Petovello
Positioning, Location and Navigation

Ming To
Digital Imaging Systems

Mark Tse
Digital Imaging Systems

Post Docs

Xiaoji Niu
Positioning, Location and Navigation

Aboelmagh Noureldin
Positioning, Location and Navigation

Muhammad Soofi
Gravity Field and Geodynamics

Visiting Scientists

Alexander V. Bogdnov
Institute of High Performance Computing and Databases, St. Petersburg, Russia

Xiao Jianguo
Chongquin Education Commission

Juhani Kakkuri, Faculty of Engineering Distinguished International Research Fellow
Geodetic Institute, Finland

Ou Keping
Chongquin Education Commission

Jingnan Liu, Faculty of Engineering Distinguished International Research Fellow
Wuhan University, China

Nie Neng
Chongquin University

Gong Shanglong
Chongquin Jiaotong University

Distinguished International Research Fellow, Professor Liu during his visit to the Department

Guest Lecturers

DISTINGUISHED LECTURE SERIES

Dr. Gerhard Beutler
University of Bern
Dr. Markus Rothacher
Technische Universitaet Muenchen
Advanced Aspects of Satellite Positioning

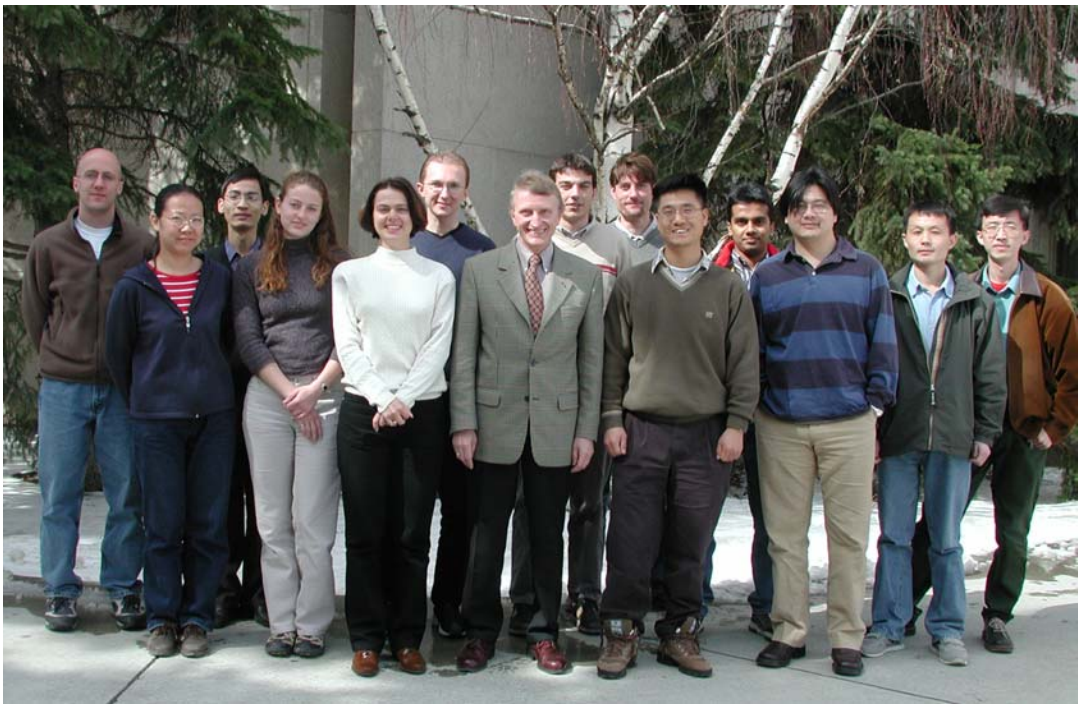
Dr. Heribert Kahmen
Technische Universitaet Wien
Positioning & Navigation for Industrial Processes

Dr. Jayanta Ray
Accord Software & Systems Inc., Alexandria, VA
Advanced GPS Receiver Technologies

Dr. Oleg Salychev
Moscow Technical University
Applied Estimation Theory in Geodetic and Navigation Applications

Dr. Hans Sünkel
Graz Unviersity of Technology
Numerical Analysis

Drs. Beutler and Rothacher (5th and 6th from the right) with graduate students enrolled in their graduate course on Precise Orbit, Advanced GPS, Precise GPS, Batch Processing



Dr. Hans Sunkel with graduate students enrolled in his graduate course on Numerical Analysis

INTERNATIONAL LECTURE SERIES

Professor Juhani Kakkuri
Geodetic Institute, Finland
1) Determination of Wo, dWo/dt and the Sea Surface Topography of the Baltic with repeated GPS and Satellite Altimetric Observations
2) Use of Deep Seismic Soundings in Geoid Modelling
3) Horizontal and Vertical Deformation of the Fennoscandian Crust

Professor Jingnan Liu
Wuhan University, China
Network RTK Research and Application in China

Dr. Matthias Pfund
Swiss Federal Institute of Technology, Switzerland
3D GIS Architecture, Data Structure and Applications

Professor Jarmo Takala
Tampere University of Technology, Finland
Parallel FFT Architectures and Data Reordering

SPECIAL LECTURE SERIES

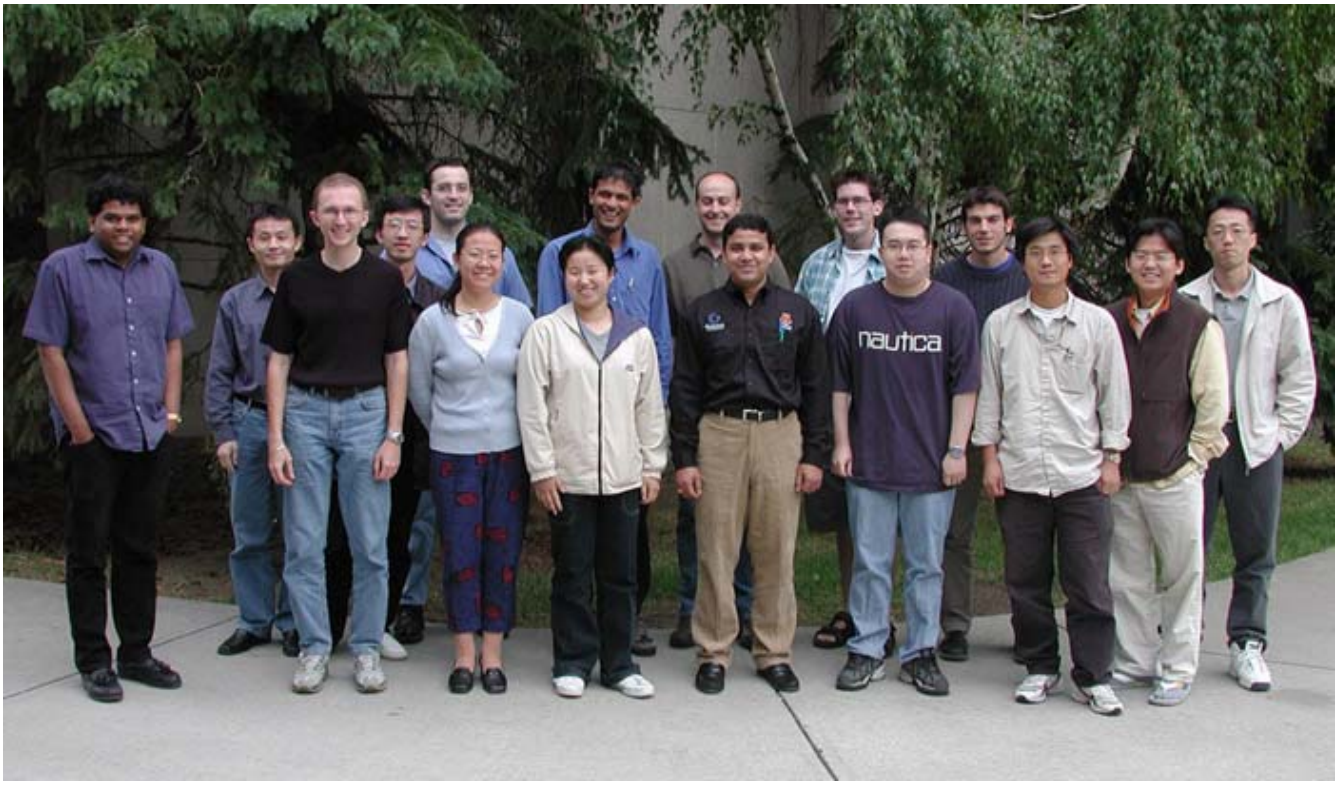
Dr. Francois Anton
University of British Columbia, BC
Voronoi Diagram for Curves and Surfaces

Dr. Jonathon Li
Ryerson Polytechnic University, ON
3D GIS on the Web for Urban Modeling and Simulation

Dr. Darka Mioc
The Voronoi Spatio-Temporal Data Structure

Professor Jorg-Rudiger Sack
Carleton University, ON
Weighted Shortest Paths Problems in 2-D and 3-D

Dr. Bo Su
Geo Environmental Net. Ltd., BC
Internet-based Spatial Data Infrastructure



Dr. Jayanta Ray with graduate students enrolled in his course on Advanced GPS Receiver Technologies

ADVISORY COMMITTEE AND STUDENT AWARDS

Advisory Committee

It is the responsibility of the Geomatics 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 26th annual advisory committee meeting was held on October 25, 2002. The agenda included discussion on the Calgary Geomatics Cluster Initiative, Career Day 2003, anticipated human resources needs by the geomatics industry, career opportunity diversification, student summer jobs, and internship opportunities. The committee also met with third and fourth year student representatives.

Back LtoR: Bruno Scherzinger, Stephen Barnett, Stephen Green, Amin Kassam , Gerard Lachapelle Front LtoR: O'Brian Blackall, Vicky Brilz, Paul Mrstik, Naser El-Sheimy, Susan Skone, Sara Masterson Front and Centre: Sara's baby

Advisory Committee 2002

Name	Affiliation
O'Brian Blackall, Chair	McElhanney Land Surveying Inc., Fort St. John, BC
Stephen Barnett	Challenger Geomatics Ltd., Calgary, AB
Vicky Brilz	Dynastream, Calgary, AB
Stephen Green	The Cadastral Group Inc., Calgary, AB
Irwin Itzkovitch	Earth Science Section, NRCan, Ottawa, ON
Amin Kassam	B.C. Ministry of Sustainable Resource Management, Victoria, BC
Tim Koepke	Indian and Northern Affairs, Whitehorse, YK
Sara Masterson	Thales GeoSolutions, San Diego, CA
Paul Mrstik	Mosaic Mapping Systems Inc., Ottawa, ON
Bruno Scherzinger	Applanix Corporation, Richmond Hill, ON
Representatives of the UofC were N. El-Sheimy, G. Lachapelle, S.H. Skone	

Geomatics Engineering Liaison Committee

Geomatics Engineering Liaison Committee 2002/2003	
Name	**Affiliation**
Ken Allred	Alberta Land Surveyors' Association
Bryan Bates	Maltais Geomatics, Member at Large
O'Brian Blackall	Corporation of British Columbia Land Surveyors
Paul Dixon	Association of Canada Lands Surveyors
Chris Korrel	Association of Manitoba Land Surveyors
Patrick Ringwood	Association of Canada Lands Surveyors
Jeff Skelton	Saskatchewan Land Surveyors' Association
Hans Troelson	Corporation of British Columbia Land Surveyors
Ross Woolgar	Alberta Land Surveyors' Association
Representatives of the UofC were M. Barry, N. El-Sheimy, M.E. Rakai, W.F. Teskey	

The Geomatics Engineering Liaison Committee met on October 24, 2002 and February 5, 2003. 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 as well as the Associate Heads and Cadastral faculty of the Department of Geomatics Engineering at the University of Calgary.

Discussions centred around further improvements to the land surveying modules that were given during Field Camp held in August, summer jobs and internship, guest presentations to students during ENGO 500 and other ENGO courses, continuing education, provincial association reports, anticipated human resources needs, and changes to the terms of reference for GELC.

Back LtoR: Mike Barry, Hans Troelsen, Jeff Skelton, Chris Korrel, Paul Woolgar, Front LtoR: Naser El-Sheimy, O'Brian Blackall, Bill Teskey, Paul Dixon, Mele Rakai, Ken Allred

Representatives from the Land Surveying Associations presented information modules to the students and met with Department faculty.

Student Awards Night

Student Awards Night was held on Thursday, October 24, 2002. Awards night is an opportunity to publicly recognize the many accomplishments of our graduate and undergraduate students. It also provides an occasion for an informal meeting between members of the profession, students, faculty and other university representatives.

The number of awards available for our students continues to rise thanks to the commitment of the Geomatics community to our program and to our students.

Geomatics Undergraduate Awards

Recipient	Awards
Natalie Glass	J.H. Holloway Scholarship in Geomatics Engineering
Benjamin Giesbrecht	British Columbia Land Surveyors Award
Scott Boulanger	L.R. (Dick) Newby Memorial Award
Jeffrey Skelton	Saskatchewan Land Surveyors Award
Jack Carter	Bryan I. Dreger Award
Benjamin Giesbrecht	LEICA Geosystems Ltd. Scholarship
Jason Klein	The McElhanney Scholarship
Lance de Groot	Stephen P. Williams Memorial Award
Jason Kang	Focus Intec Geomatics Bursary
Joel Maduck	The Cannon-Lachapelle Family Scholarship
Daniel Edwards	KIS97 Undergrad Scholarship
Zdravka Bastrak	The E.J. Krakiwsky Bursary
Jeffrey Blatz	H. Roy Goldfinch Memorial Award
David Chiu	Institute of Navigation Alberta Chapter Bursary
Leonard Yu	David Scovill Memorial Bursary
Jeffrey Blatz	Alberta Land Surveyors' Association Bursary
Gordon Copithorne	Canadian Geomatic Solutions Ltd. Bursary
Jeremy Allan	A.D. (Denis) Hosford Scholarship
David Chiu	Ray Lowry Memorial Bursary

Some of the Graduate and Undergraduate Award Winners

Ross Woolgar presented the Alberta Land Surveyors' Association Bursary

Graduate Awards	
Walid Abdel-Hamid	Egyptian Government Scholarship
Paul Alves	NSERC Scholarship Dean's Research Excellence Award
Scott Crawford	NSERC Scholarship Dean's Research Excellence Award iCORE Supplement
Cam Ellum	Izaak Walton Killam Memorial Izaak Walton Killam Research Grant
Georgia Fotopolous	NSERC Scholarship iCORE Supplement Ralph Steinhauer Award of Distinction Honorary Izaak Walton Killam Memorial Honorary Izaak Walton Research Grant Helmut Moritz Graduate Award
Thilanka Galappaththi	NSERC Industrial Postgraduate Scholarship
James Hopkins	Alberta Graduate Scholarship
Yong Hu	University of Calgary Silver Anniversary Graduate Fellowship ASPRS Abrams Grant Award
Andrew Hunter	GEOIDE Partners Research Award
Alan Ip	NSERC Industrial Postgraduate Scholarship
Glen MacGougan	NSERC Scholarship iCORE Supplement
Nayalya Nicholson	NSERC Scholarship Dean's Research Excellence Award iCORE Supplement Meteorological Service of Canada (NSERC) ESS-NSERC Graduate Supplement
Kyle O'Keefe	NSERC Scholarship Honorary Izaak Walton Killam Memorial Honorary Izaak Walton Killam Research Grant KIS-94 Graduate Scholarship Dean's Research Excellence Award

	Graduate Awards (continued)
Mark Petovello	ION
Samantha Poon	Alberta Graduate Scholarship
Rebeca Quinonez-Pinon	Consejo Nacional De Ciencia Y Tecnologia
Rob Radovanovic	NSERC Scholarship L. R. (Dick) Newby Memorial Award
Todd Richert	NSERC Industrial Postgraduate Scholarship Alberta Ingenuity Award Alberta Ingenuity Award Research Grant
Nadia Shahriari Namini	World Fellowship Grant , Delta Kappa Gamma Society International Alberta Heritage Masters Graduate Student Scholarship
Jayanti Sharma	Julie Payette NSERC Scholarship Dean's Research Excellence Award
Matthias Weigelt	Werner Graupe
Total Awarded	**$362,769**

Best paper awards were also won for papers co-authored by graduate students and faculty
Please see Awards and Recognition section on page 6 for details.

Our graduate students achieved over $362,700 in awards for 2002/2003. This figure is excluding graduate teaching assistantships and graduate research scholarships.

WOMEN IN SCIENCE AND ENGINEERING

The NSERC/Petro-Canada Chair for Women in Science and Engineering, held by Professor M.E. Cannon, finished a five year term in July, 2002. With the completion of this term, the University appointed a WISE Coordinator, Ms. Tamara McCarron who is responsible for the operation of existing initiatives as well as leading the organization in the development and implementation of new programs. Specific roles of the WISE Coordinator are to provide support to the Gender and Diversity in Engineering Committee, the graduate students networking, organization of Explore IT, Meet the Dean and Women in Engineering Day. In addition, the coordinator provides logistical support to student groups, develops new initiatives and liaises with women in the science and engineering research community and provide support where appropriate. It is the hope of both faculties that this position will help lead the institution to further success in recruiting, retaining and attracting women into the fields of science and engineering.

One of the most exciting highlights from this past year was the success of the SCIberMENTOR program. The SCIberMENTOR program was initiated in April, 2001 as a means to increase the science awareness of Alberta girls aged 11 to 18 through one-on-one email mentoring by women studying or practicing science and engineering. Since its inception, the program has grown to over 700 participants with 58% of mentees living outside of Calgary and Edmonton! These 350 'matched pairs' significantly exceed the original target of 150 matched pairs in the second year of operation (and the target of 250 pairs in year 3), and based on these participation levels and program feedback, SCIberMENTOR can be considered highly successful. Ongoing research with the mentors and mentees will provide further understanding to the benefits of this program. SCIberMENTOR is a collaborative effort between the Universities of Calgary and Alberta and the Alberta Women's Science Network (AWSN). Funding for the program is provided by Alberta Innovation and Science and EnCana Corporation.

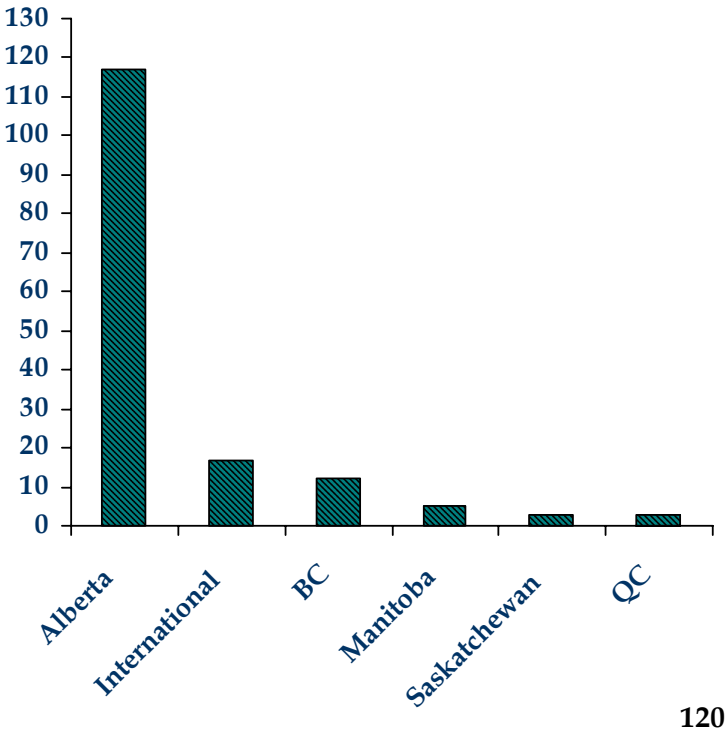
For Information on the SCIberMENTOR program visit

www.scibermentor.ca

Kimber and Lindsay meet for the first time after emailing each other for a year at the inaugural SCIberMINGLE held at the University Club in June 2002

UNDERGRADUATE STUDIES

Enrollment

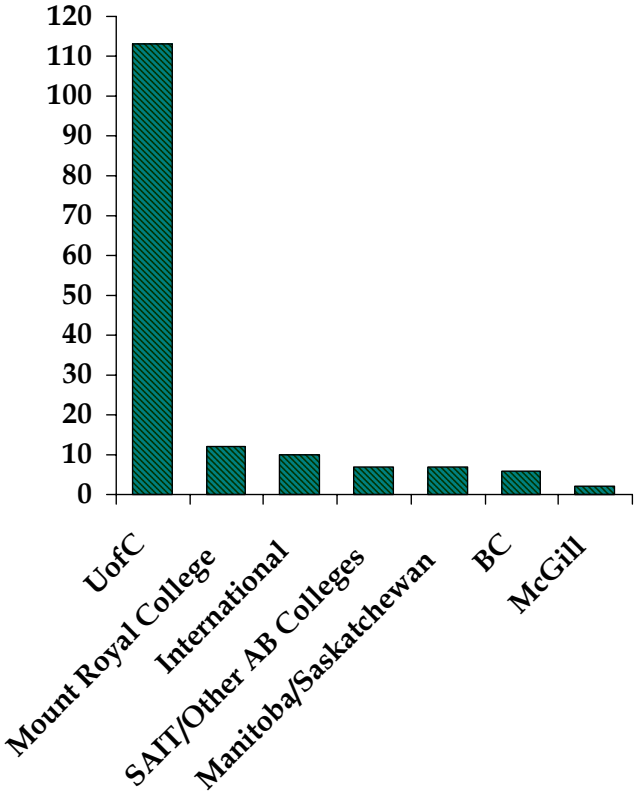


Student Enrollment by Geographic Region

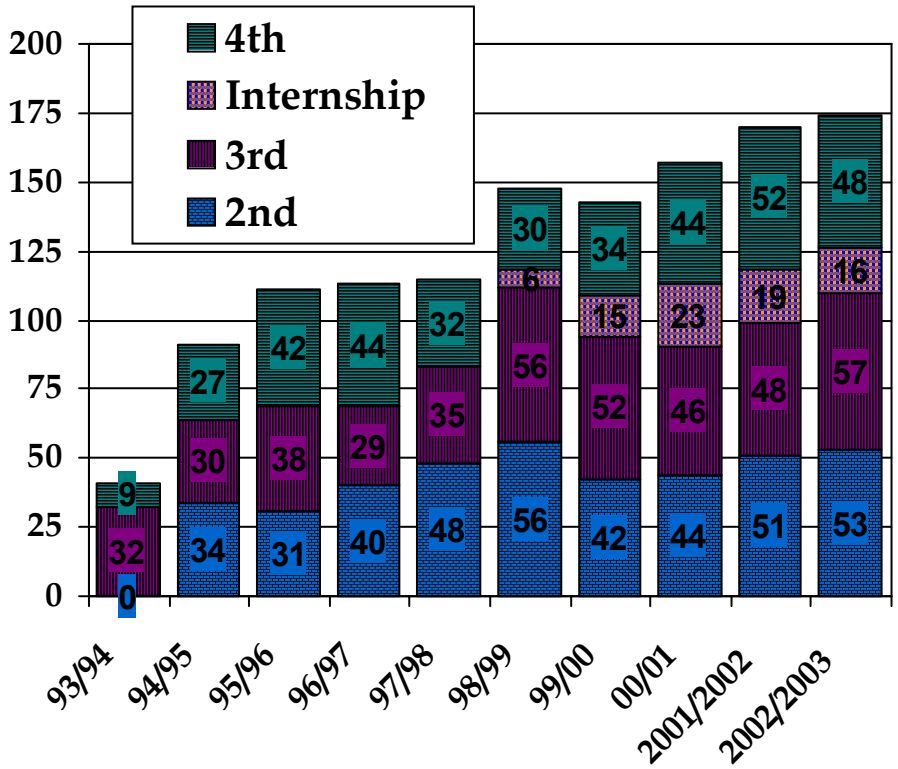
During the 2002/03 academic year 157 undergraduate students (173 including internship) pursued studies in Geomatics Engineering at the UofC (see tables on pages 32-33.

The Department has seen a steady increase in undergraduate enrolment over the past seven years (see graph on page

A representation of enrollment statistics by post secondary institution is shown in the adjacent figure. Alberta post-secondary institutions listed under Other AB Institutes include Red Deer College, Athabasca University and NAIT. MB Institutes include Red River College, University of Manitoba and University of Winnipeg, Saskatchewn includes University of Regina; BC includes BCIT and Kwantlen.



Student Enrollment by Previous Post-Secondary Institution



Undergraduate enrolment 1993/94 to 2002/2003

Fourth Year Students			
Audette, Ryan	Barvir, Adam	Beblow, Terry	Blatz, Jefferey
Boulanger, Scott	Burke, Ryan	Cheng, Rita	Clement, Barry
Fox, Tyler	Geary, Rod	Hocker, Benjamin	Howden, Jeremy
Kalmanovitch, Daniel	Klein, Jason	Kwan, Ngai	Langen, Daniel
Langen, Douglas	Lee, Melissa	Macdonald, David	Madejski, Mariusz
Magowan, Kevin	Mcallister, David	Mceachern, Michael	*Moholdt, Geir
Nemrava, Kevin	Neufeld, Jonathon	Parmar, Davinder	Prokopetz, Michael
Pullivelli, Anoop	Pyc, Jack	Sereda, David	Shayestehfar, Kiarash
Simmons, Amy	Sinanan, Leannah	Temraz, Sawsan	Tsar, Chun Yeung
Tse, Chi Fu	Tsoi, Raymond	Vanderwey, Matthew	Vincendeau, Rachel
*Waese, Christopher	Weimann, Franz	White, Craig	Wojciechowski, Adam
Wong, Johnny	Wong, Kin Yan	Yoon, Chang Bae	Yousuf, Ruben
TOTAL: 48			
***Visiting**			

Third Year Students			
Adair, Jeffrey	Anderson, Teresa	Ashton, Christopher	Barrett, Michelle
Basrak, Zdravka	Bily, Lana	Braseal, Ryan	Broadbent, Michael
Carter, Jack	Chu, Thien Chi	Colpitts, Christopher	Colpitts, Jennifer
Dixon, Luke	Dixon, Ryan	Forrester, Lindsay	Forsyth, Matthew
Fraser, Michael	Giesbrecht, Benjamin	Gordon, Ryan	Ho, Aaron
Huber, Colin	Kang, Jason	Kuzek, Dallas	Latos, Andrea
Lippitt, Warren	Lloyd, Aaron	Louie, Michael	Lui, Robert
Luu, John	Mahendru, Sachin Kumar	Malmquist, Christian	Mansour, Vivianne
Mauch, Jesse	Mckee, Donald	McKellar, Ryan	Metheral-Christ, Andrew
Na, Thomas	Nastiuk, Andrew	Nikkel, Darren	Plante, Justin
Prescot, Sara	Rangayyan, Vidya	Rasmussen, Johnathon	Somborovic, Vanesa
Thompson, Michael	Tippett, Natasha	Tong, John Ka Lung	Wards, Sandra
Wetherup, Patrick	Wollersheim, Michael	Wong, Jason	Wong, Sheena
Yang, Ying Di Diana	Yap, Ernest	Yazdani, Kambiz	Yu, Leonard
TOTAL: 56			

Second Year Students			
Al-barwani, Tariq	Anderson, Scott	Assem, Karim	Bansal, Nitin
Barnes, Joel	Beaugrand, Chris	Beck, Kyle	Beck, Michael
Berg, Erin Lisa	Bryan, Meredith	Chan, Norman	Chiu, David
Christie, Tricia	Clapperton, Aaron	Deis, Richard	Dmitriev, Elena
Dobson, Ryan	Dunn, Carina	Edwards, Daniel	Ferguson, Colin
Gerein, Jerrad	Henry, Cameron	Heuchert, Michael	Johnston, Christina
Kitchen, Cole	Koev, Stoyan	Lam, Ho Wai	Larose, Rachelle
Laurie, Byron	Lee, Dana	Lee, Michael Philip	Lovse, Krista
MacCue, Jeremy	Maduck, Joel	Mcleod, Keith	McNabb, Kari-Ann
Miller, Nicole	Olsen, Jeff	Penner, Thomas	Pokol, Chase
Rowe, Bryce	Setiawan, Jennifer Lee	Sick, Lesley	Sikkes, Nathan
Slen, Scott	Staniforth, Robert	Swerid, Darren	Teng, Charles Li-Hsing
Tingley, Jon	Walker, Ryan	Willms, Tim	Wregget, Jordan
Yuen, Elaine			
TOTAL: 53			

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 their 4th term.

COMMON PROGRAM FOR ALL ENGINEERING STUDENTS

Year 1	Course Name		Term Course Offered In
	AMAT 217	Calculus for Engineers & Scientists	F
	AMAT 219	Multivariable Calculus for Engineers	W
	CHEM 209	General Chemistry for Engineers	F/W
	ENGG 201	Behaviour of Liquids, Gases & Solids	F/W
	ENGG 205	Engineering Mechanics I	F
	ENGG 233	Computing for Engineers I	F
	ENGG 251	Design & Communication I	F
	ENGG 253	Design & Communication II	W
	MATH 221	Linear Algebra for Scientists & Engineers	F
	PHYS 259	Electricity & Magnetism	W
		Complementary Studies Course	
	Depending on assigned program, students will be registered in five half courses in one term and six half courses in the other term.		
Year 2 (Fall)			
	AMAT 307	Differential Equations for Engineers	F
	ENGG 313	Engineering Drawing & Computer Graphics	F
	ENGG 319	Probability & Statistics for Engineers	F
	ENGG 325	Electric Circuits & Systems	F
	ENGG 335	Computing for Engineers II	F

Abbreviations	
AMAT	Dept. of Math. and Stats.
CHEM	Dept. of Chemistry
PHYS	Dept. of Physics
ENGG	Faculty of Engineering
ENGO	Dept. of Geomatics Engineering

Undergraduate Curriculum in Geomatics Engineering

UNDERGRADUATE CURRICULUM IN GEOMATICS ENGINEERING			
Year 2/Winter	**Course**		**Stream**
	AMAT 309	Vector Calculus for Engineers	
	ENEL 327	Signals and Transforms	
	ENGO 343	Fundamentals of Surveying	Surveying
	ENGO 351	Introduction to Geospatial Information Systems (LIS)	Land Studies
	ENGO 361	Adjustments of Observations	Methodology
	ENGG 003	Block Course/Environment, Health and Safety	
	COST-2	Complementary Study	
Year 3/Fall	**Course**		**Stream**
	ENCI 471	Introduction to Project Management	Methodology
	ENGG 407	Numerical Methods	Methodology
	ENGO 421	Fundamentals of Geodesy	Geodesy
	ENGO 431	Analytical Photogrammetry	Photogrammetry and Remote Sensing
	ENGO 455	Cadastral Surveys & Land Registration Systems	Land Studies
	COST-3	Complementary Study	
Year 3/Winter	**Course**		**Stream**
	ENGO 423	Geodetic Positioning	Geodesy
	ENGO 427	Gravity Field	Geodesy
	ENGO 435	Physical Principles of Remote Sensing	Photogrammetry and Remote Sensing
	ENGO 459	Design & Implementation of Geospatial Information Systems	Land Studies
	COST-4	Complementary Study	
Year 4/Fall	**Course**		**Stream**
	ENGG 513	Role & Responsibility of Prof. Engineers in Society	Practical
	ENGO 500	Geomatics Engineering Project	Practical
	ENGO 501	Field Surveys	Practical
	ENGO 545	Hydrography	Positioning, Location and Navigation
	TE-1	Technical Elective	
	COST-5	Complementary Study	
Year 4/Winter	**Course**		**Stream**
	ENGO 500	Geomatics Engineering Project	Practical
	ENGO 519	Geomatics Networks	Surveying
	TE-2	Technical Elective	
	TE-3	Technical Elective	
	TE-4	Technical Elective	
	COST-6	Complementary Study	

The first year and a half (three terms) of common core subjects are followed by two and a half years (five terms) which concentrate on geomatics related subjects. The curriculum for the remaining five terms is shown in the adjacent table.

TECHNICAL ELECTIVES
GEOMATICS ENGINEERING

Course		Stream
ENGO 559	Digital Imaging and Applications	Digital Imaging Systems
ENGO 561	GPS	Positioning, Location and Navigation
ENGO 563	Data Analysis in Engineering	Geodesy and Reference Systems
ENGO 567	High-Precision Surveys	Engineering Metrology
ENGO 573	Digital Terrain Modelling	Digital Imaging Systemsng
ENGO 579	Survey Law	GIS and Land Tenure
ENGO 581	Land Use Planning	GIS and Land Tenure
ENGO 583	Environmental Modelling	GIS and Land Tenure
SGMA 395	Legal Environment	

Geomatics Engineering Student Society (GESS)

President: Barry Clement
VP Treasurer: Aaron Ho
VP Events: Dallas Kuzek
VP Academic: Amy Simmons
3rd year rep: Natasha Tippett
2nd year rep: Cole Kitchen
Career Day Coordinator: Kevin Nemrava

Students at Career Day

ENGO 500

The objective of the ENGO 500 group project course is 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: R. Audette, R. Burke, J. Neufeld and D. Parmar.

ENGO 500 Special Presentations

Ms. Diane Coleman
Earth Observation Services
20 Years of Project Management in Geomatics

Mr. John Holmlund
President, Focus Corporation
International Geomatics Project Management

Dr. Gerard Lachapelle
Dept. of Geomatics Engineering, UofC
The Survey for the Canadian Pacific Tunnel

Dr. Matthew Tait
Dept. of Geomatics Engineering, UofC
Geomatics Project Management in Europe

Dr. Doug Tindall
Faculty of Engineering, Engineer in Residence
Integrated Product Teams in Project Management

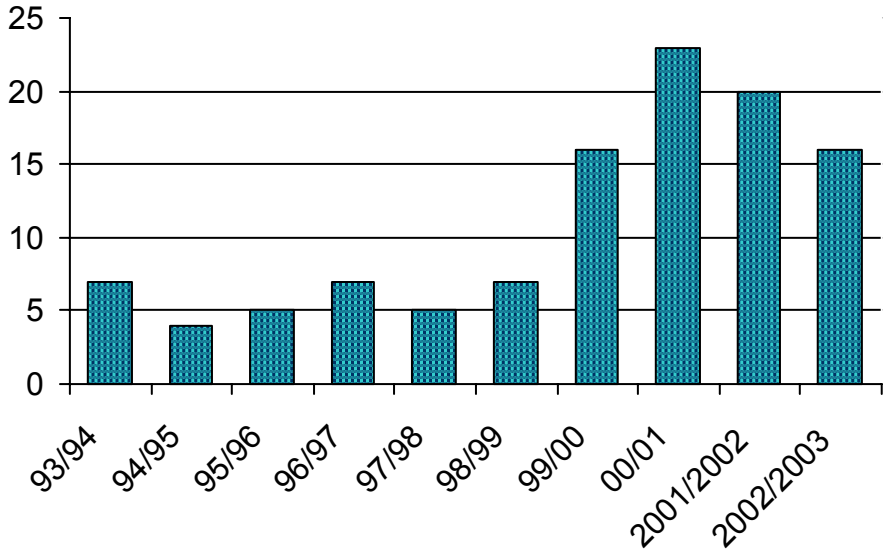
ENGO 500 Projects (2002/03)		
Project Title	**Group Members**	**Supervisor**
Comparing the Algorithms Between High Resolution Satellite Images and Digital Maps for Road Change Detection	M. Tse, K. Shayastehfar, C. Kwan, S. Temraz	I. Couloigner
Web-based Forest Fire Early Warning System	A. Simmons, A. Pullivelli, A. Barvir, A. Wojciechowski	N. El-Sheimy
Researching and Testing New WADGPS Carrier Phase Correction Services	R. Audette, R. Burke, J. Neufeld, D. Parmar	Y. Gao
DGPS over tcp/ip Connections	R. Vincendeau, C. Yoon, D. Kalmanovitch, M. Madejski	R.W. Klukas
Sirf High-Sensitivity Receiver Test Under Forest Canopy	Dan Langen, Doug Langen, D. MacDonald, D. Sereda	G. Lachapelle
The Development of a GPS Network in Southern Alberta	K. Nemrava, T. Fox, M. Prokopetz	G. Lachapelle
Whiskey Ridge Subdivision	J. Blatz, J. Pyc, C. White, J. Klein	M.E. Rakai
Development of a Software Package for the Correction of Digital Side-Scan Sonar Imagery	S. Boulanger, B. Hocker, J. Howden, K. Magowan	S.H. Skone
Snow Loading Gravity Effect	M. Vanderwey, R. Tsoi, Y. Wong, C. Tsar	N.J. Sneeuw
Validation of 3D Laser Scanning and Conceptual Definition of a 3D GIS for Use in the Petrochemical Industry	R. Cheng, B. Clement, M. Lee, L. Sinanan	M.P. Tait
The Planning, Design, and Implementation Procedures Involved in Beginning a New Subdivision	J. Wong, M. McEachern, T. Beblow	W.F. Teskey
Comparison of Biomass Estimation Models Using Various Types of Satellite Imagery	D. McAllister, R. Yousuf	C. Valeo

Engineering Internship Program

Geomatics Internship Students 2002/2003		
Name	**Placement Company**	**Faculty Mentor**
Jeremy Allan	Intermap Technologies Corporation	M.J. Collin
Lance de Groot	University of Calgary	G. Lachapelle
Dallin Doney	UMA Engineering Ltd.	M.E. Rakai
Brian Elsayed	McElhanney Land Surveys Ltd.	N. El-Sheimy
Natalie Glass	Intermap Technologies Corporation	I. Couloigner
Robert Glass	Sanborn Colorado, LLC	S.H. Skone
Tyler Hansen	Challenger Geomatics Ltd	M.B. Barry
Tony Ho	Fisheries & Oceans Canada	M.B. Barry
Jonathan Hooper	Autodesk Inc.	N.J. Sneeuw
Stephen Hyatt	Autodesk Inc.	Y. Gao
Andrea Johnson	GeoAnalytic Inc.	C. Valeo
Jina Lee	TransCanada	W.F. Teskey
Derek Loo	Waypoint Consulting Inc.	R.W. Klukas
Irwindeep Natt	Focus Intec	D. Mioc
Sabrina Szeto	Intermap Technologies Corporation	M.E. Rakai
Daniel Woodhouse	Aerotec	M.P. Tait

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

The number of internship placements from 1993/94 to 2002/2003 is shown in the graph below. It is the Department's goal to have 25 students participating in the program per year.



Number of Internship Students Placed 1993/94 to 2002/03

Geomatics Engineering Career Day

On February 6, 2003, the Geomatics Engineering Student's Society and the Department of Geomatics Engineering hosted their eighth 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.

Career Day Participants

Alberta Geomatics Group	Focus Corporation
Alberta Land Surveyors' Association	Fugro SESL Geomatics
All West Surveys Ltd.	Intermap Technologies Corp.
All-Can Engineering & Surveys Ltd.	ITRES Research Limited
Applanix Corporation	Maltais Associates Surveyors Ltd.
Association of Canada Lands Surveyors	McElhanney Land Surveys Ltd.
Can-Am Geomatics Corp.	Mosaic Mapping
Cansel	Motorola
Century Subsea Inc.	NovAtel Inc.
Challenger Geomatics Ltd.	Sanborn
Crape Geomatics Corporation	The Cadastral Group Inc.
Eagle Navigation Systems Inc.	Trimble Navigation
EBA Engineering Consultants Ltd.	

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

Career Day in the Rozsa Centre

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.

Top of the Mountain

The Department of Geomatics Engineering would like to thank the following companies for their participation in the annual Survey Camp Equipment Day on Monday, August 19 and for the generous loan of equipment over the duration of Survey Camp:

Butler Survey Supplies Ltd.
Cansel Survey Equipment
NovAtel Inc.
Point Inc.
Spatial Technologies Inc.
Southern Alberta Institute of Technology

Field Camp students and instructors

GRADUATE STUDIES

Enrollment

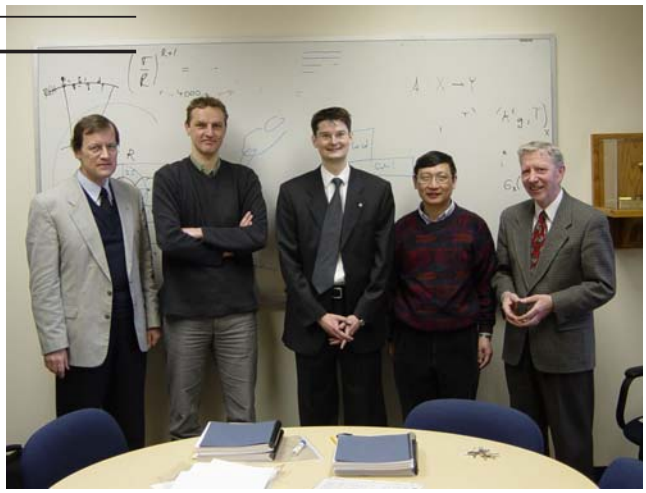
The number of graduate students climbed significantly to a total of 97 (87 full time, 9 part time and 1 visiting). During the academic year 2002/2003, students were either enrolled in the graduate program or finishing their theses. Thirty-three were working towards their PhD degree, 58 towards their MSc degree and 6 towards their MEng degree. Students originated from 20 different countries. There were 20 students that graduated during the reporting period, four with a PhD degree, 12 with a MSc and four with an MEng. Details are given in the following tables.

Graduate enrolment climbed from 69 to 97 students

PhD Students 2002/2003			
Name	**Supervisor**	**Name**	**Supervisor**
Abdel-Hamid, Walid	El-Sheimy/Lachapelle	Liu, Zhizhao	Gao
Abdel-Salam, Mohamed	Gao	Ma, Changlin	Lachapelle/Klukas
Ahn,, Yong Won	Lachapelle	Mezentsev, Oleg	Lachapelle
Al-Ruzouq, Rami	Habib	Morgan, Michel	Habib
Alves, Paul	Lachapelle	Nassar, Sameh	El-Sheimy/Schwarz
Basnayake, Chaminda	Lachapelle/MacIar	Nicholson, Natalya	Skone/Cannon
Chen, Kongzhe	Gao	O'Keefe, Kyle	Lachapelle
Chiang, Kai-Wei	El-Sheimy	Petovello, Mark	Lachapelle
Ellum, Cameron	El-Sheimy	Provins, Dean	Blais
Fotopoulos, Georgia	El-Sheimy/Sideris	Quinonez-Pinon, Rebeca	Collins/Valeo
Ghanma, Mwafag	Habib	Raaflaub, Lynn	Valeo
Grebenitcharsky, Rossen	Sideris	Radovanovic, Robert	Teskey/El-Sheimy
Hu, Yong	Valeo/Collins	Rajabi, Mohammad	Blais/Lachapelle
Hunter, Andrew	El-Sheimy/Mioc	Shin, Eun Hwan	El-Sheimy
Julien, Olivier	Lachapelle/Cannon	Zheng, Bo	Lachapelle
Kern, Michael	Schwarz		
Total 31			

MSc and MEng Students 2002/2003			
Name	**Supervisor**	**Name**	**Supervisor**
MSc Students			
Crawford Scott	Cannon	Moon, Yongjin	Skone
Dao, Diep Thi Hong	Lachapelle	Olynik, Michael	Cannon
de Jong, Michael	Collins	Park, Minha	Gao
Deshpande, Sameet	Cannon	Poon, Samamtha	Valeo
Dong, Lei	Lachapelle	Raaflaub, Lynn	Collins
El-Gizawy, Mahmoud	Skone	Rangelova, Elena	Sideris
El-Habiby, Mohamed	Sideris	Richert, Todd	El-Sheimy
Ford, Tom	Schwarz	Salman, Syed	Cannon
Fox, Ryan	Teskey/Tait	Salycheva, Anastasisa	Cannon
Galappaththi, Thilanka	El-Sheimy	Shahriari Namini, Nadia	El-Sheimy
Ho, Carrie	Valeo	Sharma, Jayanti	Collins
Hou, Haiying	El-Sheimy	Shen, Xiaobing	Gao
Hoyle, Victoria	Skone	Sheng, Li (Tony)	Tait
Huang, Andrew	Collins	Shrestha, Sudhir Man	Skone
Ip, Alan	El-Sheimy	Singh, Sanjeet	Klukas/Cannon
Jiang, Zhi	Lachapelle	Trevis, Landra	El-Sheimy
Karunanayake, M. Dhar	Cannon	Wang, ChaoChao	Lachapelle/Cannon
Kennedy, Sandra	Schwarz	Wang, Jau-Hsiung (James)	Gao
Kubacki, Wojciech	Cannon	Watson, John	Klukas/Lachapelle
Lee, Suen	Gao	Wright, Bruce	El-Sheimy
Lian, Ping	Lachapelle	Xu, Chen	Sneeuw/Sideris
Lin, Tsai-Chung (Roger)	Valeo	Zhang, Hai Tao	Cannon
Liu, Junjie	Cannon	Zhang, Huasiu (Larry)	Blais
Liu, Zhe	Gao	Zhang, Qiao Ping	Couloigner
Lu, Yan	Lachapelle	Zhang, Wentao	Cannon
MacGougan, Glenn	Lachapelle	Zhang, Xiaohong	Cannon
Mao, Liman	Rakai		
MEng Students			
Alton, David	Collins	Weigelt, Matthias L. B.	Sneeuw/Sideris
Hopkins, Jamie	Teskey		
Total 56			

Part-Time and Visiting Graduate Students 2002/2003				
Name	**MEng**	**MSc**	**PhD**	**Supervisor**
Auld, Jonathan	1			Cannon
Angelo, Joseph		1		Lachapelle/Cannon
Bajracharya, Sujan		1		Sideris
Bates, Marcia	1			Cannon
Gaidadjiev, Radoslav		1		Tait
Manz, Allan	1			Cannon
Morin, Kris		1		El-Sheimy
Ryan, Samuel			1	Lachapelle
* Tocho, Claudia			1	Sideris
Wu, Huming		1		Cannon
TOTAL	3	5	2	
*Visiting				
External Supervision				
Fonescu, Edvaldo University of Sao Paulo, Brazil			1	Lachapelle (Co-Supervisor)
Jensen, Anna University of Copenhagen, Denmark			1	Cannon (Co-Supervisor)
Pugliano, Giovanni Parthenope University of Naples, Italy			1	Lachapelle
TOTAL			3	



PhD defence: LtoR: Petr Holata (external examiner), Dr. Nico Sneeuw, Michael Kern (PhD stuent), Dr. Patrick Wu and Dr. Klaus-Peter Schwarz (supervisor)

Students Graduated from other Universities with Co-Supervision from Geomatics Engineering Faculty

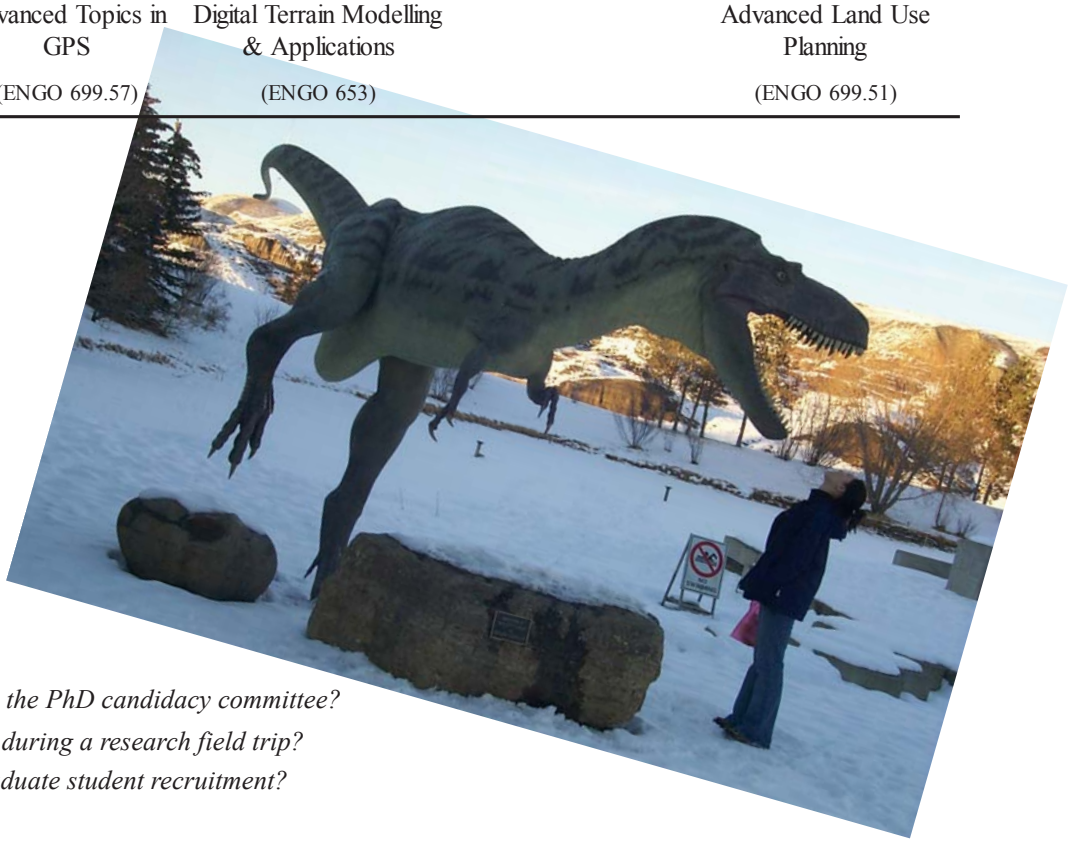
Name	Degree	Institution	Graduate Thesis Title	Supervisor
Edvaldo Fonseca	PhD	University of Sao Paulo, Brazil	Using the GPS System to Estimate the Ionospheric Refraction in Brazil	G. Lachapelle
Anna Jensen	PhD	University of Copenhagen, Denmark	Numerical Weather Predictions for Network RTK	M.E. Cannon
Giovanni Pugliano	PhD	Universita' Degli Studi di Napoli Parthenope, Italy	"Tecnica GPS Multi-Reference Station - Principi E Applicazione Del Systema MultiRef	G. Lachapelle

Graduate Studies Convocants 2002/2003

Name	Degree	Exam Date	Graduate Thesis Title	Supervisor
Mark Petovello	PhD	Apr 10/03	Real-Time Integration of Tactical-Grade IMU and GPS for High-Accuracy Positioning and Navigation	G. Lachapelle
Michael Kern	PhD	Apr 03/03	An Analysis of the Combination and Downward Continuation of Satellite, Airborne and Terrestrial Gravity Data	K.P. Schwarz
Mahmoud El-Gizawy	MSc	Mar 24/03	Development of an Ionospheric Monitoring Technique Using GPS Measurements for High Latitude GPS Users	S.H. Skone
Jonathan Auld	MEng	Jan 27/03	n/a	M.E. Cannon
Jungie Liu	MSc	Jan 10/03	Implementation and Analysis of GPS Ambiguity Resolution Strategies in Single and Multiple Reference Station Scenarios	M.E. Cannon
David Alton	MEng	Dec 20/02	n/a	M.J. Collins
Yan Lu	MEng	Dec 16/02	n/a	G. Lachapelle
Carrie Ho	MSc	Dec 06/02	Urban Snow Hydrology and Modelling	C. Valeo
Xiaobing Shen	MSc	Dec 05/02	Improving Ambiguity Convergence in Carrier Phase-Based Precise Point Positioning	Y. Gao
Nadia Shahriari Namini	MSc	Nov 29/02	A New Approach for Simplification of Linear Vector Data for Internet-based GIS Applications	N. El-Sheimy
Marcia Bates	MEng	Dec 16/02	n/a	M.E. Cannon
Kristian Morin	MSc	Nov 08/02	Calibration of Airborne Laser Scanners	N. El-Sheimy
Rob Radovanovic	PhD	Oct 11/02	Adjustment of Satellite Based Ranging Observations for Precise Positioning and Deformation Monitoring	N. El-Sheimy
Samuel Ryan	PhD	Oct 10/02	Augmentation of DGPS for Marine Navigation	G. Lachapelle
Andrew Hunter	MSc	Sept 19/02	"Mobile GIS as if Field Users Mattered: Small is Ubiquitous but can Speech be Recognized?"	N. El-Sheimy
Lynn Raaflaub	MSc	Sept 06/02	The Effect of Error in Gridded Digital Elevation Models on Topographic Analysis and on the Distributed Hydrological Model TOPMODEL	M.J. Collins
Michael de Jong	MSc	July 15/02	Guided Super- Resolution	M.J. Collins
Michael Olynik	MSc	July 05/02	Temporal Characteristics of GPS Error Sources and their Impact on Point Positioning	M.E. Cannon
Zhe Liu	MSc	May 06/02	A Java-Based Wireless Framework for Location-Based Service Applications	Y. Gao
Sandra Kennedy	MSc	May 03/02	Acceleration Estimation from GPS Carrier Phases for Airborne Gravimetry	K.P. Schwarz

Graduate Seminars - 2002/2003	
Name	**Topic**
Walid Abdel-Hamid	Thermal and Noise Characteristics of MEMS Inertial Sensors
Paul Alves	Advanced Topics in Network RTK: Ionosphere Modeling and Network Positioning
Kai-Wei Chaing	INS/GPS Integration Using Neural Networks For Land Vehicle Navigation Applications
Mahmoud El-Gizawy	Ionospheric Modelling Using GPS
Georgia Fotopoulos	On the Estimation of Variance Components Using GPS, Geoid and Levelling Data
Carrie Ho	An Urban Field Study To Improve Urban Snow Modeling
Michael Kern	The Downward Continuation Problem - Analysis, Challenges and Solutions
	A Comparison of Methods for the Combination of Satellite and Local Gravity Data
Junjie Liu	Test and Evaluation of the Use of GPS Multi-Reference Stations
Changlin Ma	Improve Wireless Location Performance via Enhanced Signal Processing Technique and the Integration of GPS and Network
	NLOS Error Mitigation in Wireless Location
Glenn MacGougan	High Sensitivity GPS Performance And Measurement Analysis
Michel Morgan	Parallel Projection Modeling of Linear Array Scanners For Normalized Scene Generation
Kris Morin	Self-Calibration of Airborne Laser Scanners
Sameh Nassar	Improving SINS Error Modeling in SINS/DGPS Applications
	Positioning Accuracy Improvement During GPS Outages Using Different SINS/GPS Bridging Methods
Kyle O'Keefe	Navigation Performance of the Proposed JPL Mars Network
Michael Olynick	Temporal Characteristics of GPS Error Sources and their Impact on Point Positioning
Mark Petovello	GPS and Medium-Performance IMU Integration: How Good Is It?
	Integrating GPS with Medium Performance IMU for High Accuracy Navigation: A Covariance Analysis
Dean Provins	Gravity Field Synthesis
Lynn Raaflaub	The Effect of Error in Gridded Digital Elevation Models on Topographic Analysis and on the Distributed Hydrological Model TOPMODEL
Mohammad Rajabi	Spatial Enhancement of Digital Elevation Models Using Shape from Shading and Single Satellite Imagery
Xiaobing Shen	Improving Ambiguity Convergence in Carrier Phase-Based Precise Point Positioning
Sudhir Man Shrestha	Tropospheric Delay And A Tomographic Approach For GPS Meteorology
ChaoChao Wang	A Low Cost Solution For GPS Based Attitude Determination
Bruce Wright	Real-time Direct Georeferencing of Thermal Video Images for Identification and Location of Forest Fire Hotspots
Huming Wu	On - The - Fly (Otf) Gps Ambiguity Resolution With Intertial Aiding
Allison Zhang	Integration Of GPS With A Medium Accuracy IMU For Metre Level Positioning

Stream 1	Stream 2	Stream 3	Stream 4	Stream 5
Gravity Field and Geodynamics	**Positioning, Location & Navigation**	**Digital Imaging Systems**	**Engineering Metrology**	**GIS, and Land Studies**
Geodetic Reference Systems (ENGO 613)	State Models, Kalman Filtering and Smoothing (ENGO 621)	Seminars in Remote Sensing Applications (ENGO 631)	Least Squares Estimation and Analysis (ENGO 629)	Case Studies in Land Information Systems (ENGO 651)
Advanced Physical Geodesy (ENGO 615)	Inertial Surveying and INS/GPS Integration (ENGO 623)	Non-Topographical Photogrammetry (ENGO 635)	Industrial and Precision Alignment Surveys (ENGO 643)	Information Extraction from Digital Imagery (ENGO 655)
Satellite Altimetry and Applications (ENGO 663	Navstar GPS: Theory and Applications (ENGO 625)	Integrated Analysis of Multi-Source Spatial Data (ENGO 637)	Modelling And Optimization Analysis (ENGO 647)	Advanced Spatial Information Systems (ENGO 661)
Global Geophysics and Geodynamics (ENGO 681)	Atmospheric Effects on Satellite Navigation System (ENGO 633)	Digital Stereo Image Processing (ENGO 639)		Advanced Survey Law (ENGO 665)
	Advanced Topics in GPS (ENGO 699.57)	Digital Terrain Modelling & Applications (ENGO 653)		Advanced Land Use Planning (ENGO 699.51)



Facing down the PhD candidacy committee?
Fun during a research field trip?
Graduate student recruitment?

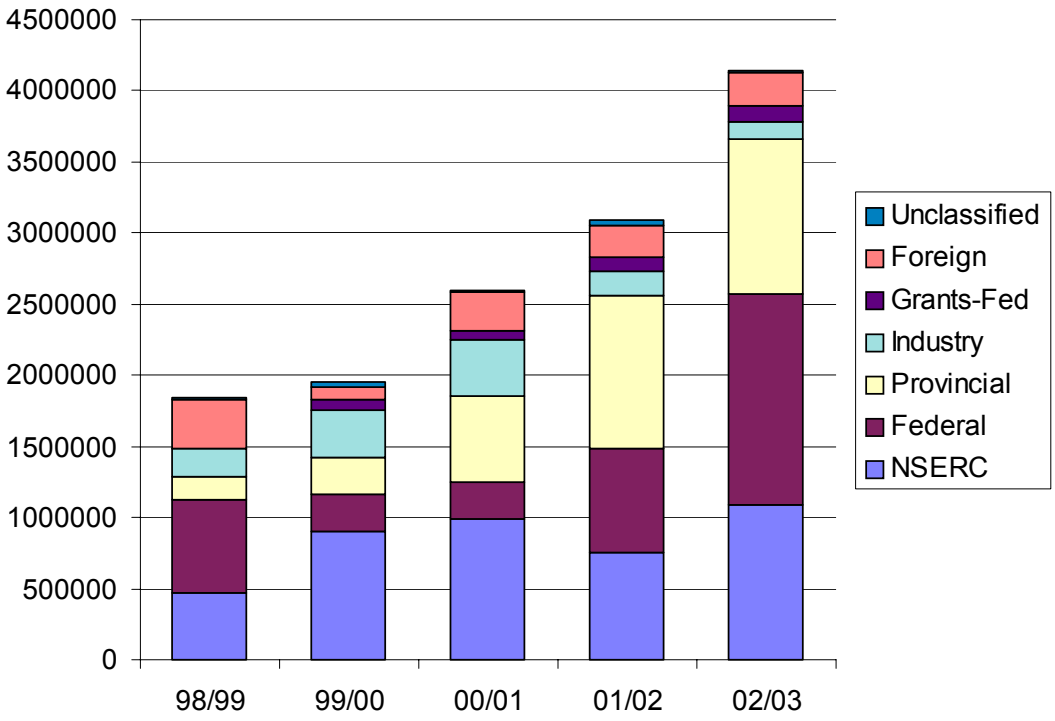
RESEARCH

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, in an indirect way, the teaching activities of the Department.

Direct research funding for this report year was at $4,143,722 which is about $259,000 per member (based on 16 faculty members). This continues to be an excellent level of support. Direct research funding increased by over $1,047,500 for the reporting period.

Direct research funding increased by over $1,047,500 for the reporting period



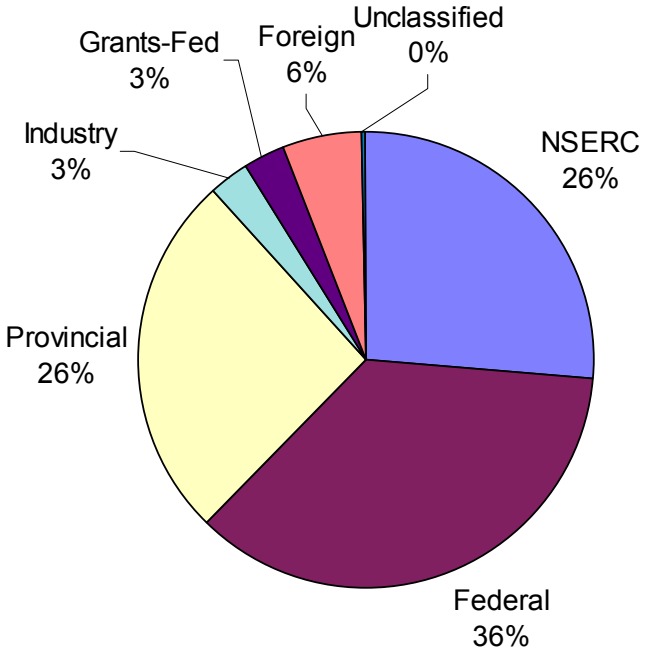
Direct Research Funding by Source - 1998/99 to 2002/03

Figure 1

Research Grants and Contracts for the Period April 1, 2002 - March 31, 2003	
Source	**Amount**
NSERC	1,088,659
Federal Government	1,488,742
Federal - Grants	120,172
Provincial Government	1,086,648
Industry	113,795
Foreign Agencies	231,848
Other	13,858
Direct Research Support	*4,143,722*
Research Scholarships	362,769
Equipment Donations/Endowment Fund	239,334
Indirect Research Support	*602,103*
Total Research Support	**4,745,825**

Table 1

Besides direct research funding, there is indirect research support available in terms of student scholarships and in-kind donations. When added to the direct project funding, see Table 1, the total research for the reporting period is $4,745,825. Figure 1 shows direct research funding for the last five years and Figure 2 shows the research funding by source for 2002/2003.



Direct Research Funding by Source - 2002/03

Figure 2

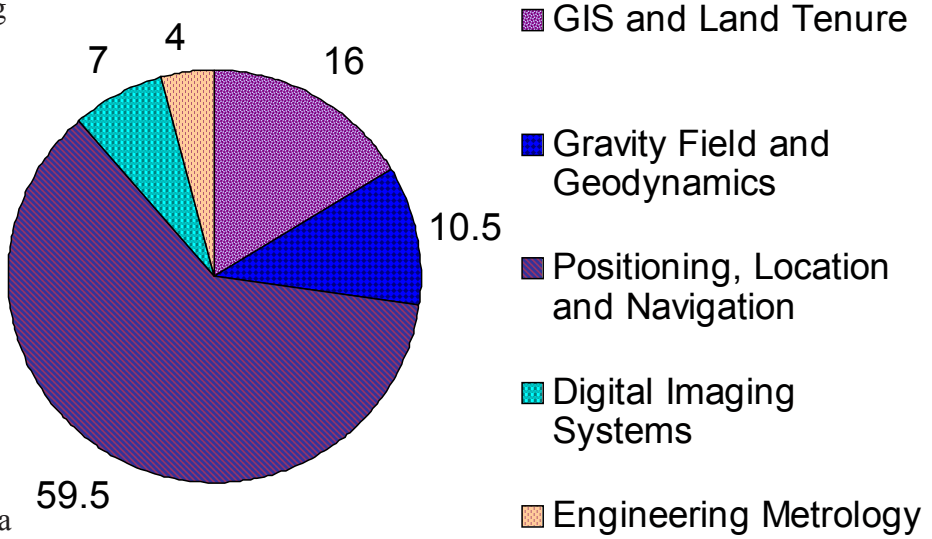
Major Research Areas

The five major research areas in the Department and the names of faculty members who worked on major projects in each area are listed in the following table.

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

Research projects being conducted in the above major research areas are listed in tables on pages 51 - 55.

The number of graduate students working in each area is indicated in Figure 3. 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 to take on major projects.



Graduate Student Distribution by Area

Figure 3

Projects in Positioning, Location and Navigation

Project Name	Contract Type	Faculty Investigators
Airborne Data Processing Using the Multiref Method in Post Mission Phase II	Industry	M.E. Cannon G. Lachapelle
Augmentation of GPS for Increased Performance	NSERC	M.E. Cannon
Atmosphere Sensing Using GPS	NSERC Strategic	M.E. Cannon G. Lachapelle Y. Gao S.H. Skone
Single Point Positioning Using GPSo.C data	Federal	M.E. Cannon G. Lachapelle Y. Gao S.H. Skone
CFI - IIPP - Multi-Sensor Lab	Federal	N. El-Sheimy S.H. Skone
CFI Career Award: Infra. for GNSS Algorithm & Application Development	Federal/Provincial	M.E. Cannon
CFI - Signal Tracking & Measurement Infra. to Support Wireless Location & Communication	Federal	M.E. Cannon N. El-Sheimy G. Lachapelle Y. Gao S.H. Skone
CRC/CFI	Provincial/Federal	G. Lachapelle
Carrier Phase Based Wide Area Differential GPS	NSERC	Y. Gao
Chair, CRC in Wireless Location/CRC	Federal/NSERC	G. Lachapelle
Collaborative Driving System	Federal	M.E. Cannon
Construction-Integrated Navigation Information System	Federal	M.E. Cannon
Evaluation of Interpolation Methods	Federal	S.H. Skone
Evaluation of Real-Time GPS Positioning	Federal	Y. Gao
GEOIDE NCE - Development of Point-RTK Technology	NSERC	Y. Gao
GEOIDE NCE - Next Generation MEMS-based Navigation System for Vehicles and Personal Location Navigation	NSERC	Y. Gao
GEOIDE NCE - Next Generation MEMS-based Navigation Systems	Federal	N. El-Sheimy

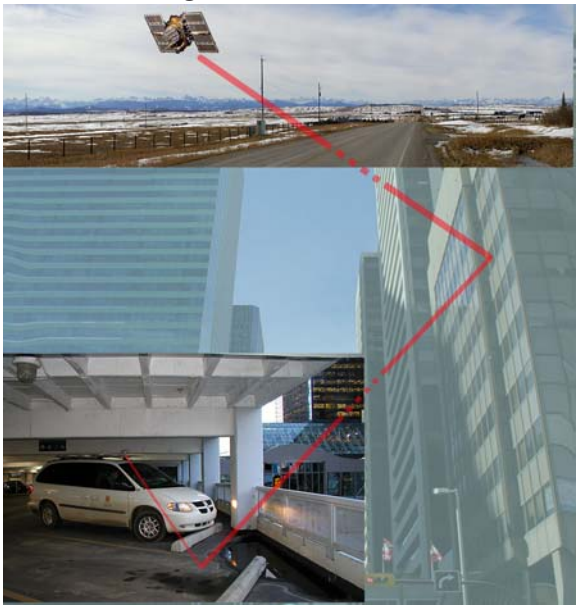
Projects in Positioning, Location and Navigation (continued)		
Project Name	**Contract Type**	**Faculty Investigators**
GPS/Galileo Interoperability Study	Federal	G. Lachapelle M.E. Cannon
GPS/INS for Formula 1 Racing Applications Signal Tracking & Measurement Infra. to Support	Industry	N. El-Sheimy
GPS-based Heading Determination	Foreign	G. Lachapelle M.E. Cannon
Gyro-Free Sensor Suite	Foreign	G. Lachapelle
High Performance MEMs	Industry	N. El-Sheimy
High Sensitivity Rx Assessment	Industry	G. Lachapelle
Hybrid Positioning of Wireless Telephones	NSERC	R.W. Klukas
iCore Chair in Wireless Location	Provincial	G. Lachapelle
Indoor GPS Channel Fading Characteristics	Provincial	R.W. Klukas
Indoor Wireless Location	Foreign	G. Lachapelle
Intelligent Shovel Excavation	Provincial	Y. Gao
Ionosphere Modelling	NSERC	S.H. Skone
JPALS Technical Support	Foreign	G. Lachapelle M.E. Cannon
Joint Approach and Landing System (JPALS) Project	Foreign	M.E. Cannon G. Lachapelle
JRAO LAR Positioning	Federal	G. Lachapelle
MEMS Based Inertial Systems for Vehicle Navigation Applications	NSERC Strategic	N. El-Sheimy Y. Gao
NCE Auto 21 Network	Federal	G. Lachapelle
NSERC UFA	NSERC	S.H. Skone
New Management System/Equip. Utilization Rate in Mining	Provincial	Y. Gao
Precise Kinematic Positioning	NSERC	G. Lachapelle
Public Works Canada	Federal	G. Lachapelle M.E. Cannon
RS/M Rx Testing	Federal	G. Lachapelle

Projects in Positioning, Location and Navigation (continued)

Project Name	Contract Type	Faculty Investigators
Regional Area GPS Kinematic Positioning Using Multiple Reference Stations	NSERC	M.E. Cannon
Regional Ionosphere Modeling	Federal	S.H. Skone
Ship Multipath Evaluation	Federal	G. Lachapelle
Steacie Research Funding	NSERC	M.E. Cannon
Tractical Outdoor Positioning Systems	Federal	G. Lachapelle R.W. Klukas
Traffic Accident Reconstruction Using GPS & Non-Metric Imgg.	Provincial	N. El-Sheimy
Validation and Testing of Ionosphere Predictions (Canadian Coast)	Federal	S.H. Skone

GPS Weather Station

High Sensitivity GPS is the future of Downtown Navigation



Projects in Engineering Metrology

Project Name	Contract Type	Faculty Investigators
Feasibility Study into the Requirements and Methods of Monitory Deformation/MacKenzie Delta	Industry	M. Tait M.E. Cannon M.J. Collins I. Couloigner G. Lachapelle S.H. Skone
High Precision Industrial Surveys	NSERC	W.F. Teskey
Real-time Network Based GPS Deformation Monitoring	Industry	W.F. Teskey

Projects in Gravity Field and Geodynamic

Project Name	Contract Type	Faculty Investigators
Airborne Gravity Systems for Geomatics and Geophysics	NSERC	K.P. Schwarz
Development of a Dynamic, Seamless, Vertical Reference System - NRCan	Federal	M.G. Sideris
Future Gravity Field Satellite Missions	Foreign	N.J. Sneeuw
GEOIDE NCE - Development of a Dynamic, Seamless, Vertical Reference System	NSERC	M.G. Sideris
GEOIDE NCE - Precise Geoid Determination	NSERC	M.G. Sideris
GEOIDE NCE - Precise Geoid Determination for Geo-Referencing and Oceanography	NSERC	M.G. Sideris
GEOIDE NCE - Seamless Vertical Reference System for Geomatics Applications	Federal	N.J. Sneeuw
Global Gravity Field Determination from Dedicated Satellite Missions	NSERC	N.J. Sneeuw
Gravity Field Determination from 3D High-Low Satellite-to-Satellite Tracking	Provincial	N.J. Sneeuw
Multiresolution Approximation of the Earth's Gravity Field	NSERC	M.G. Sideris
REE - Gravity Field Determination	Provincial	N.J. Sneeuw

Projects in GIS and Land Tenure

Project Name	Contract Type	Faculty Investigators
Data Structure and Algorithms for Raster/Vector GIS Integration	Provincial	D. Mioc
Disturbance Modelling in Forested Watershed	Federal	C. Valeo
Enhancing Water Supply Infra. Investment Planning Practices for a Changing Climate	Federal	C. Valeo
Faculty of Engineering Starter Grant	Provincial	D. Mioc
Land Reform and Restitution in Southern Africa	Foreign	M.B. Barry
Grizzly Bear Tracking Collar	Provincial	N. El-Sheimy
REE - Environmental and Water Resources Engg	Provincial	C. Valeo
Real-time Airborne Mapping System	NSERC	N. El-Sheimy
Real Time Internet-based Surveillance of Oil/Gas Pipeline	Provincial	N. El-Sheimy
Topographically Dependent Correlation Function	Provincial	C. Valeo
Variable Source-Area Modelling in Mixed Land Use	NSERC	C. Valeo

Control Surveys for Planning Land Reform Projects: Western Cape, South Africa

Projects in Digital Imaging Systems		
Project Name	**Contract Type**	**Faculty Investigators**
DolSAR and InSAR Analysis	Federal	M.J. Collins
Epipolar Image Resampling from Push-Broom Imagery	Foreign	A.F. Habib
GEOIDE NCE - Automating 3D Feature Extraction and Change Detection	Federal	I. Couloigner
GEOIDE NCE - Hyperspectral Applications for Renewable and Mineral Resources	Federal	M.J. Collins
Faculty of Engineering Starter Grant	Provincial	A.F. Habib
Integration of Remote Sensing and Physical Process Modelling	NSERC	M.J. Collins
Man-made Features Extraction from High Resolution Imagery in Urban Areas	NSERC	I. Couloigner
Potentials of Multi-Source Data Fusion	Provincial	I. Couloigner
Research Support for Radarsat 2	Federal	M.J. Collins
Software Development for Digital Camera Calibration	Foreign	A.F. Habib

Registration of IKONOS and KOMPSAT Scenes

PUBLICATIONS

Books and Chapters

Adlard, G., M. Barry *et al* (23 authors) (2003), **Informal Settlements Handbook**, Sections on Land Tenure, Land Registration and Cadastral Survey. Provincial Government of the Western Cape, South Africa, Department of Housing,http://www.westerncape.gov.za/housing/whatsnew/Informal_Settlements_Handbook.asp

De Jong, C.D., G. Lachapelle, S. Skone, and I.A. Elema (2002), **Hydrography, Series on Mathematical Geodesy and Positioning**, Delft University Press, 353 pages (ISBN 90-407-2359-1).

Warren, A.J., M.J. Collins, E.A. Johnson and P. Ehlers (2002), **Managing Uncertainty in a Geospatial Model of Biodiversity, In: Uncertainty in GIS and Remote Sensing**, P. Atkinson and G. Foody (Eds), John Wiley and Sons.

Refereed Journals

Bajracharya, S., C. Kotsakis and M.G. Sideris (2002), Aliasing Effects on Terrain Correction Computation Using Constant and Lateral Density Variations, **International Geoid Service Bulletin No. 12**, pp. 38-47.

Barry, M. and C. Fourie (2002), Wicked Problems, Soft Systems and Cadastral Systems in Periods of Uncertainty: South African Experience, **Survey Review, 36, 285**, pp. 483-496.

Barry, M., L. Roux, G. Barodien, and I. Bishop (2002), Video-evidencing and Palmtop Computer Technology to Support Formalising Land Rights, **Development Southern Africa, 19, 2,** pp. 261-272.

Bishop, I.D., M. Barry, E. McPherson, J. Nascarella, K. Urqhuart, and F. Escobar (2002), Meeting the Need for GIS Skills in Developing Countries: The Case of Informal Settlements, **Transactions in GIS, 6,** pp. 311-326.

Blais, J.A.R. (2002), Reliability Considerations in Geospatial Information Systems, **Geomatica, 56, 4**, pp. 341-350.

Blais, J.A.R. and D.A. Provins (2002), Spherical Harmonic Analysis and Synthesis for Global Multiresolution Applications, **Journal of Geodesy, 76, 1**, pp. 29-35.

Cannon, M.E., G. Lachapelle, G. MacGougan, R. Klukas, P. Boulton, and A. Read (2003), Weak Signal Environment Testing of a High Sensitivity GPS Receiver in the Laboratory, **GPS World, 14, 3,** pp. 24-32.

Chiant, K., A. Noureldin, and N. El-Sheimy (2003), Multi-sensors Integration using Neuron Computing for Land Vehicle Navigation, **GPS Solutions, Journal, 6, 3**, pp. 209-218.

Couloigner I., C. Djima, E. LeBlanc, Y. Bédard, B. Moulin, and K.P.B.Thomson (2002), Towards Automating the Selection of Ground Control Points in Radarsat Images Using a Topographic Database and Vector-based Data Matching, **Photogrammetric Engineering & Remote Sensing, 68, 5**, pp. 433-440.

Ellum, C.M. and N. El-Sheimy (2002), Kinematic Attitude Determination from GPS Derived Accelerations and a Tri-Axial Accelerometer, Navigation, **Journal of the USA Institute of Navigation, 49, 3,** pp. 117-126.

Fortes, L.P., M.E. Cannon, S. Skone, and G. Lachapelle (2002), Improving a Multi-reference GPS station Network Method for OTF Positioning in the St. Lawrence Seaway, **Lighthouse, 61 (Spring/Summer), Canadian Hydrographic Association**, pp. 4-11.

Fotopoulos, G., C. Kotsakis, and M.G. Sideris (2002), Determination of the Achievable Accuracy of Relative GPS/Geoid Levelling in Northern Canada, **International Geoid Service Bulletin No. 12**, pp. 29-37.

Fotopoulos, G., C. Kotsakis, and M.G. Sideris (2003), How Accurately can we Determine Orthometric Height Differences from GPS and Geoid Data? **Journal of Surveying Engineering, 129, 1,** pp. 1-10.

Gao, Y. and X. Liao (2002), Ionosphere Modeling Using Carrier Smoothed Ionosphere Observations From a Regional GPS Network, **Geomatica, 56, 2**, pp. 97-106.

Gao, Y. and X. Shen (2002), A New Method for Carrier Phase Based Precise Point Positioning, **Navigation, Journal of the Institute of Navigation, 49, 2**, pp. 109-116.

Gao, Y. and Z.Z. Liu (2002), High Precision Ionosphere Modeling Using Regional GPS Network Data, **Journal of Global Positioning Systems, 1, 1**, pp. 18-24.

Gao, Y., X. Shen, and M. Abdel-Salem (2002), Global Differential GPS without a Base Station, **Journal of Geographic Information Sciences, 8, 1**, pp. 9-15.

Habib, A. and M. Morgan (2003), Automatic Calibration of Low-Cost Digital Cameras, **Journal of Optical Engineering, 42, 4,** pp. 948-955.

Habib, A., Y. Lee, and M. Morgan (2003), Automatic Matching and Three-Dimensional Reconstruction of Free-Form Linear Features from Stereo Images, **Journal of Photogrammetric Engineering and Remote Sensing, 69, 2,** pp. 189-197.

Habib, A., Y. Lee, M. Morgan (2002), Bundle Adjustment with Self-Calibration using Straight Lines, **Photogrammetric Record Journal, 17, 100**, pp. 635-650.

Lachapelle, G., G. Pugliano (2002), Posizionamento GPS Network RTK: il metodo MultiRefä. **Bollettino della SIFET**, **No. 3**, pp. 5-15.

Lachapelle, G., M.E. Cannon, K. O'Keefe, and P. Alves (2002), How will Galileo Improve Positioning Performance? **GPS World, 13, 9**, pp. 38-48.

Losch, M., B.M. Sloyan, J. Schroeter, and N. Sneeuw (2002), Box Inverse Models, Altimetry and the Geoid: Problems with the Omission Error, **Journal of Geophysical Research 107, C7,** 10.1029/2001JC000855

Lupart, J.L. and M.E. Cannon (2002), Do Grade 7 Junior High School Students Differ in Computer Use, Future Plans and Career Choices?, **Alberta Gifted and Talented Education Journal, 15, 1**, pp. 3-13.

Lupart, J.L. and M.E. Cannon (2002), Computers and Career Choices: Gender Differences in Grade 7 and 10 Students, **Journal on Gender, Technology and Development, 6, 2**, pp. 234-248.

MacGougan, G., G. Lachapelle, R. Klukas, K. Siu, L. Garin, J. Shewfelt, and G. Cox (2002), Performance Analysis of A Stand-Alone High Sensitivity Receiver. **GPS Solutions**, **6, 3**, pp. 179-195.

Novak, P., M. Kern, K.P. Schwarz, M.G. Sideris, B. Heck, S. Ferguson, Y. Hammada, and M. Wei (2002), On Geoid Determination from Airborne Gravity, **Journal of Geodesy, 76, 9-10**, pp. 510-522.

Oberndorfer, H., J. Mueller, R. Rummel, and N. Sneeuw (2002), A Simulation Tool for the New Gravity Field Satellite Missions, **Advanced Space Research 30, 2**, pp. 227-232

O'Keefe, K., S. Ryan, and G. Lachapelle (2002), Global Availability and Reliability Assessment of the GPS and Galileo Global Navigation Satellite Systems, **Canadian Aeronautics and Space Journal**, **Canadian Aeronautics and Space Institute, 48, 2**, pp. 123-132

Olynik, M., M.G. Petovello, M.E. Cannon and G. Lachapelle (2002), Temporal Impact of Selected GPS Errors on Point Positioning, **GPS Solutions, 6, 1-2**,

pp. 47-57.
Skone, S. and S. Shrestha (2002), Limitations in GPS Positioning Accuracies at Low Latitudes During Solar Maximum, **Geophysical Research Letters,** May 28.
Skone, S., V. Hoyle, S. Lee, and S. Poon (2002), Variations in Point Positioning Accuracies for Single Frequency GPS Users During Solar Maximum, **Geomatica, 56, 2**, pp. 131-140.
Sneeuw, N.J., J.v.d. Ijssel, R. Koop, P. Visser, and C. Gerlach (2002), Validation of Fast Pre-mission Error Analysis of the GOCE Gradiometry Mission by a Full Gravity Field Recovery Simulation, **Journal of Geodynamics 33, 1-2**, pp. 43-52
Teskey, W. F. and R.S. Radovanovic (2002), Dynamic Parallel Roll Alignment, **Journal of Surveying Engineering, 128, 3**, pp. 136 - 143.
Varner, C.C. and M.E. Cannon (2002), Developing Carrier Phase DGPS Networks with Partial Derivative Algorithms, **ASCE Journal of Surveying Engineering, 128, 2**, pp. 39-60.
Vergos, G.S. and M.G. Sideris (2002), Evaluation of Geoid Models and Validation of Geoid and GPS/leveling Undulations in Canada, **International Geoid Service Bulletin No. 12**, pp. 3-17.
Wang, C., and G. Lachapelle (2002), GPS Attitude Determination Reliability Performance Improvement Using Low Cost Receivers. **Journal of Global Positioning Systems, 1, 2,** pp. 85-95.

Proceedings

Abdel-Hamid, W., A Noureldin, N. El-Sheimy, and G. Lachapelle (2002), Performance Analysis of MEMS-based Inertial Sensors for Positioning Applications, **Proceedings of International Workshop on System-on-Chip for Real-Time Applications**, Banff, AB, July 6-7, Kluwer Academic Publishers, pp. 440-450.
Abdel-Salam, M., Y. Gao, and X. Shen (2002), Analyzing the Performance Characteristics of a Precise Point Positioning System, **Proceedings of ION GPS 2002**, Portland, OR, September 24-27, pp. 1893-1899.
Alves, P., G. Lachapelle, M.E. Cannon, L. Fortes, and J. Park (2002), Use of Self-Contained Ionospheric Modeling to Enhance Long Baseline Multiple Reference Station RTK Positioning, **Proceedings of the ION GPS 2002**, Portland,

Graduate Students attending the ION GPS Conference in Portland, Oregon.

OR, September 24-27, pp. 1388-1399.

Anton, F. and D. Mioc (2002), An Exact Algebraic Predicate for the Maintenance of the Topology of the Additively Weighted Voronoi Diagram, **The 14th Canadian Conference in Computational Geometry,** Lethbridge, AB, August 12-14, pp. 72-76.

Aquino, M., S. Waugh, A. Dodson, T. Moore, and S. Skone (2002), GPS based Ionospheric Scintillation Monitoring, **Proceedings of the ESA Space Weather Workshop - ESTEC**, Noordwijk, December 17-19, CD.

Barry, M., I. Elema and P. van der Molen (2003), Ocean Governance in the Netherlands North Sea, **Federation Internationale des Geometres (FIG) Working Week**, Paris, April 13-17.

Barry, M. and J. Whittal (2003), The Geomatics Curriculum at the University of Cape Town: A Model for Developing Countries, **Federation Internationale des Geometres (FIG) Working Week,** Paris, April 13-17.

Basnayake, C., G. Lachapelle, and A. MacIver (2003), A GPS-Based Calibration Tool for Microscopic Traffic Simulation Models, **Proceedings of SMART Moving Conference**, Birmingham, UK, April 7-10, CD.

Bayoud, F.A. and M.G. Sideris (2002), Geoid determination from airborne gravity data using different filtering frequencies and DTM resolutions, **Proceedings of the 2001 International Association of Geodesy Scientific Assembly,** IAG Symposia Vol. 125 - Vistas for Geodesy in the New Millennium (J. Adam, K.P. Schwarz, Eds.), Budapest, Hungary, Sept. 2-7, 2001, pp. 217-222.

Boulton, P., A. Read, G. MacGougan, R. Klukas, E. Cannon, and G. Lachapelle (2002), Proposed Models and Methodologies for Verification Testing of AGPS-Equipped Cellular Mobile Phones in the Laboratory, **Proceedings of the ION GPS 2002**, Portland, OR, September 24-27, pp. 200-212. (Best Paper Presentation Award)

Cannon, M.E., S. Skone, Y. Gao, Y. Moon, K. Chen, S. Crawford, and G. Lachapelle (2002), Performance Evaluation of Several Wide-area GPS Services, **Proceedings of the ION GPS 2002**, Portland, OR, September 24-27, pp. 1716-1726, (Best Presentation Award)

Chen, K., Y. Gao, and X. Shen (2002), An Analysis of Single Point Positioning with Real-Time Internet-based Precise GPS Data, **Proceedings of International Symposium on GPS/GNSS**, Wuhan, China, November 6-8, CD.

Chiang, KW. and N. El-Sheimy (2002), INS/GPS Integration Using Neural Networks for Land Vehicle Navigation Applications, **Proceedings of the ION GPS 2002**, September 24-27, Portland, OR, CD.

Collin, J., G. Lachapelle, and J. Kappi (2002), MEMS-IMU for Personal Positioning in a Vehicle - A Gyro-Free Approach, **Proceedings of GPS 2002**, Portland, OR, September 24-27, pp. 1153-1161.

Couloigner, I., E. LeBlanc, C. Djima, Y. Bédard, B. Moulin, K.P.B. Thomson, C. Latouche, and N. Spicher (2002), Using Multisource Databases for Automated Identification of Control Points on RADARSAT Images, **Proceedings of the 22nd EARSeL Symposium on Remote Sensing**, Prague, Czech Republic, June 4-6, pp. 43-47.

El-Gizawy, M. and S. Skone (2002), A Canadian Ionospheric Warning and Alert System, **Proceedings of the ION GPS 2002**, Portland, OR, September 24-27, pp. 1345-1352.

Ellum, C.M. and N. El-Sheimy (2002), The Calibration of Image-Based Mobile Mapping Systems, **IAG 2nd Symposium on Geodesy for Geotechnical and Structural Engineering**, Berlin, Germany, May 21-24, CD.

El-Sheimy, N., H. Kinawi, and M.M. Reda Taha (2003), Structural Monitoring Using "Wirelessly" Connected MEMS-based Sensors: Towards System Development, **Proceedings of the International Conference on Performance of Construction Materialsl (ICPCM)**, A.S. El-Dieb, M. M. Reda Taha, and S.L. Lissel, Eds., Cairo, Egypt, February, pp. 439-448.

Gao, Y., X. Shen, and M. Abdel-Salem (2002), Global Differential GPS without Using a Base Station, **Proceedings of Geoinformatics 2002**, Nanjing, China, June 1-3.

Gerlach, C., N. Sneeuw, P. Visser, and D. Svehla (2003), CHAMP Gravity Field Recovery with the Energy Balance Approach: First Results, **First CHAMP Mission Results for Gravity, Magnetic and Atmospheric Studies**, (Ch. Reigber, H. Luehr, P. Schwintzer (eds.) pp. 134-139.

Grebenitcharsky R.S. and M.G. Sideris (2002), Altimetry-gravimetry Boundary Value Problems with Smoothness Conditions in Coastal Regions, **Proceedings of the XXVI General Assembly of the European Geophysical Society** (I.N. Tziavos and R. Barzaghi, Eds.), March 25-30, 2001, Nice, France. Special Issue of IGeS Bulletin Vol. 13, pp. 121-132.

Grebenitcharsky, R.S., G.S. Vergos, and M.G. Sideris (2002), Combination of Gravity, Altimetry and GPS/Leveling Data for the Numerical Solution of the Altimetry-gravimetry Boundary Value Problems, **Proceedings of the 2001 International Association of Geodesy Scientific Assembly**, IAG Symposia Vol. 125 - Vistas for Geodesy in the New Millennium (J. Adam, K.P. Schwarz, Eds.), Budapest, Hungary, Sept. 2-7, 2001, pp. 150-155.

Habib, A. and M. Morgan (2002), New Approach for Calibrating Off-the-shelf Digital Cameras, **Proceedings of the Land Satellite Information IV/ISPRS Commission I Symposium**, Denver, CO, November 10-15, CD.

Habib, A., S. Shin, and M. Morgan (2002), Automatic Pose Estimation of Imagery Using Free-Form Control Linear Features, **ISPRS Commission III Symposium "Photogrammetric Computer Vision",** Graz, Austria, September 9-13, CD.

Habib, A., S. Shin, and M. Morgan (2002), New Approach for Calibrating Off-the-Shelf Digital Cameras, **ISPRS Commission III Symposium "Photogrammetric Computer Vision",** Graz, Austria, September 9-13, CD.

Ho, C.L.I. and C. Valeo (2002), An Urban Snow Field Study to Improve Urban Snow Modelling, **Canadian Water Resources Association 55th Annual Conference**, June 11-14, Winnipeg, MB, CD.

Jacobsen, M., J.L. Lupart, and M.E. Cannon (2002), An Exploration of Gender Differences In Computer Usage and Affinity, and the Relationship With Career Plans and Adult Life Choices, **Proceedings of ICWES12 Conference**, Ottawa, July 25-31, CD.

Julien, O., P. Alves, M.E. Cannon, and W. Zhang (2003), A Tightly Coupled GPS/GALILEO Combination for Improved Ambiguity Resolution, **Proceedings of the GNSS 2003 Conference**, Graz, April 24-26, CD.

Kinawi, H., M.M. Reda Taha, and N. El-Shiemy (2002), Structural Health Monitoring Using the Semantic Wireless Web: A Novel Application For Wireless Networking, **Proceedings of the 27th Annual IEEE Conference on Local Computer Networks (LCN)**, Hassanain, H. et al., Ed., Tampa, FL, CD.

Kotsakis, C and M.G. Sideris (2002), Aliasing Error Modelling in Single-Input Single-Output Linear Estimation Systems, **IAG Symposia (M.G. Sideris, ed.), Gravity, Geoid and Geodynamics, vol. 123**, July 31-August 4, 2000, Banff,

AB, pp. 43-48, Springer-Verlag, New York.

Kotsakis, C. and M.G. Sideris (2002), Non-stationary noise filtering of gravity data using fast spectral techniques, **Proceedings of the XXVI General Assembly of the European Geophysical Society** (I.N. Tziavos and R. Barzaghi, Eds.), March 25-30, 2001, Nice, France. Special Issue of IGeS Bulletin Vol. 13, pp. 35-40.

Kotsakis, C., G. Fotopoulos, and M.G. Sideris (2002), A Study on the Effects of Data Accuracy and Datum Inconsistencies on Relative GPS Levelling, **Proceedings of the International Association of Geodesy Symposia Vol. 124** (H. Drewes, A.H. Dodson, L.P.S. Fortes, L. Sanchez and P. Sandoval, Eds.), Cartagena, Colombia, Feb. 20-23, 2001, pp. 113-118. Springer-Verlag Berlin Heidelberg New York.

Kris, M. and N. El-Sheimy (2002), Adjustment of LIDAR Data, **FIG Paper the FIG XXII International Congress**, Washington, D.C., April 19-26, CD.

Lachapelle, G. (2002), Global Navigation Satellite Systems: Emerging Capabilities and Research Opportunities, **Veikko A. Heiskanen Symposium- A look to the future**, Columbus, OH, October 2-4, CD.

Lachapelle, G., J. Clark, and R. Breslau (2002), Real Time Measurement of GPS Antenna Motion For JPALS, **RTO-SET Fall 2002 Symposium on Emerging Military Capabilities Enabled by Advances in Navigation Sensors**, Istanbul, October 14-16, CD.

Lachapelle, G., M.E. Cannon, R. Klukas, G. MacGougan, and P. Boulton (2003), Hardware Simulator Models and Methodologies for Controlled Performance Assessment of High Sensitivity AGPS Receivers, **Proceedings of the GNSS 2003 Conference**, Graz, April 24-26, CD.

Lachapelle, G., M.E. Cannon, R. Klukas, S. Singh, R. Watson, P. Boulton, A. Read, and K. Jones (2003), Hardware Simulator Models and Methodologies for Controlled Performance Assessment of High Sensitivity AGPS Receivers, **Proceedings of GNSS 2003, The European Navigation Conference**, Graz, Austria, April 22-25, CD

Lee, S. and Y. Gao (2002), Mobile Asset Tracking and Management Over the Web, **Proceedings of the 2nd Symposium on Geodesy for Geotechnical and Structural Engineering**, Berlin, Germany, May 21-24, pp. 483-492.

Lee, Y., A. Habib (2002), Pose Estimation of Line Cameras Using Linear Features, **Proceedings of ISPRS Commission III Symposium "Photogrammetric Computer Vision"**, Graz, Austria, September 9-13, CD.

Lee, Y., A. Habib, and K. Kim (2002), A Study on Aerial Triangulation from Multi-Sensor Imagery, **Proceedings of the International Symposium on Remote Sensing (ISRS),** Sokcho, Korea, October 30-November 1, pp. 400-406.

Leonard, A., H. Krag, G. Lachapelle, K. O'Keefe, C. Huth, and C. Seynat (2003), Impact of GPS and Galileo Orbital Plane Drifts in Interoperability Performance Parameters, **Proceedings of GNSS 2003, The European Navigation Conference**, Graz, Austria, April 22-25, CD.

Liu, J., and P. Alves, M. Petovello, G. MacGougan, M.E. Cannon, and G. Lachapelle (2002), Development and Testing of an Optimal Cascading Scheme to Resolve Multi-Frequency Carrier Phase Ambiguities, **Proceedings of the ION GPS 2002**, Portland, OR, September 24-27, pp. 933-944.

Liu, Z. and Y. Gao (2002), Performance Analysis of a 3D Ionosphere Tomographic Model, **Proceedings of International Symposium on GPS/GNSS**, Wuhan, China, November 6-8, CD.

Liu, Z.Z. and Y. Gao (2002), Accuracy Analysis of a 3-D Ionospheric Tomogra-

phy Model, **Proceedings of ION GPS 2002**, Portland, OR, September 24-27, pp. 1307-1312.

Lupart, J.L. and M.E. Cannon (2002), SCIberMENTOR: Connecting Young Girls and Adult Mentors in Science, In F.J. Monks & H. Wanger (Eds.), **Proceedings of the 8th Conference of the European Council for High Ability (ECHA),** Rhodes, October 9-13, pp. 230-232.

Lupart, J.L. and M.E. Cannon (2002), Student Interest and Choice in Science and School Achievement, **Proceedings of the 8th Conference of the European Council for High Ability (ECHA)**, Rhodes, October 9-13.

Ma, C., R. Klukas, and G. Lachapelle (2003), Mitigation of NLOS Error in AOA Wireless Location. **Proceedings of 17th Annual International Symposium on AeroSense**, SPIE Vol. 5084, Orlando, April 21-25, CD.

Ma, C., R. Klukas, and G. Lachapelle (2002), An Efficient NLOS Error Mitigation Method for Wireless Location, **Proceedings of TRLab Wireless 2002**, Calgary, AB, July 8-10, pp. 160-167

MacGougan, G. and J. Liu (2002), Fault Detection Methods and Testing, **Proceedings of ION GPS 2002**, Portland, OR, September 24-27, pp. 2668-2678, (Best Student Paper Award and Best Session Paper).

Mezentsev, O., Y. Lu, G. Lachapelle, and R. Klukas (2002), Vehicular Navigation in Urban Canyons Using a High Sensitivity Receiver Augmented with a Low Cost Sensor, **Proceedings of ION GPS 2002**, Portland, OR, September 24-27, pp. 363-369.

Mueller, J., H. Oberndorfer, C. Gerlach, and N. Sneeuw (2002), Recent Simulation of the Gravity Field Mission GOCE, **Proceedings of the IAG General Assembly 2001**, Budapest, CD.

Noureldin A., E.H. Shin, and N. El-Sheimy (2002), Improving the Performance of Inertial Sensor Alignment Using Adaptive Pre-Filtering Techniques, **Proceedings of ION 58th Annual Meeting**, Albuquerque, NM, June 24-26. CD.

Park, J.U., J.H. Joh, H.C. Lim, P.H. Park, B.H. Choi, S.W. Lee, B. Townsend, M.E. Cannon, and G. Lachapelle (2002), Multi-Reference GPS Network for the Nationwide RTK Service in Korea, **Proceedings of the ION GPS 2002**, Portland, OR, September 24-27, pp. 2334-2341.

Park, M. and Y. Gao (2002), Development of an Internet-Based Mobile Equipment Management System, **Proceedings of FIG XXII International Congress**, Washington, D.C., April 19-26, CD.

Park, M. and Y. Gao (2002), Error Analysis of Low-Cost MEMS-Based Accelerometers for Land Vehicle Navigation, **Proceedings of ION GPS 2002**, Portland, OR, September 24-27, pp. 1162-1170.

Peters, T., J. Mueller, and N. Sneeuw (2002), Temporal Variations in the Earth's Gravity Field, Vortraege beim 4. **DFG-Rundegespraech im Rahmen des Foschungsvorhaben Deutsche Geodaetische Kommission**, Reihe, A., Heft Nr. 118, (H. Schuh, M. Soffell, H. Hornik eds.) pp. 133-140.

Petovello, M., M.E. Cannon, and G. Lachapelle (2003), Quantifying Improvements From the Integration of GPS and a Tactical Grade INS in High Accuracy Navigation Applications, **Proceedings of the ION NTM**, Anaheim, January 22-24, pp. 454-465.

Petovello, M.G., M.E. Cannon, and G. Lachapelle (2003), Kalman Filter Reliability Analysis Using Different Update Strategies, **Proceedings of the CASI Conference**, Ottawa, April 28-30.

Pyryt, M., J.L. Lupart, and M.E. Cannon (2002), Predicting Science Achievement in Males and Females: Perceptions of Science, **Proceedings of ICWES12 Con-**

ference, Ottawa, July-25-31, CD.

Radovanovic, R.S. and N. El-Sheimy (2002), Precise Positioning using Network DGPS via Optimal Linear Combination Determination, **Proceedings of ION 58th Annual Meeting**, Albuquerque, NM, June 24-26, CD.

Rajabi, M.A. and J.A.R. Blais (2002), Improvements of Digital Terrain Model Interpolation Using SFS Techniques with Single Satellite Imagery, **Computational Science – Part III**, P.M.A. Sloot, C.J.K. Tan, J.J. Dongarra, and A.G. Hoekstra Eds., Lecture Notes in Computer Science, 2331, April 21-24, pp. 164-173.

Reda Taha, M. M., H. Kinawi, and N. El-Sheimy (2002), The Realization of Commercial Structural Health Monitoring Using Information Technology Based Techniques, **First International Workshop On Structural Health Monitoring**, Winnipeg, MB, August, CD.

Seedahmed, G., and A. Habib (2002), A Linear Approach to Single Photo Resection in a Planar Object Space, **ISPRS Commission III Symposium "Photogrammetric Computer Vision",** Graz, Austria, September 9-13, CD.

Seedahmed, G. and A. Habib (2002), Retrieval of the Calibration Matrix from the 3-D Projective Camera Model, **ISPRS Commission III Symposium "Photogrammetric Computer Vision",** Graz, Austria, September 9 - 13, CD.

Shen, X. and Y. Gao (2002), Ambiguity Pseudo-fixing in Precise Single Point Positioning GPS, **Proceedings of ION 58th Annual Meeting**, Albuquerque, New Mexico, June 24-26, pp. 163-168.

Shen, X. and Y. Gao (2002), Kinematic Processing Analysis of Carrier Phase based Precise Point Positioning, **Proceedings of FIG XXII International Congress**, Washington, D.C., April 19-26, CD.

Shin, E.H. and N. El-Sheimy (2002), Optimizing Smoothing Computation for Near Real-Time GPS Measurement Gap Filling in INS/GPS Systems, **Proceedings of the ION GPS 2002**, September 24, Portland, OR, CD.

Skone, S., M. El-Gizawy, and S.M. Shrestha (2002), Comprehensive analysis of DGPS Performance During Solar Maximum, **Proceedings of the Ionospheric Effects Symposium**, Alexandria, VA, May 7-9, pp. 5A7-1 - 5A7-8.

Skone, S., M.E. Cannon, D. Karunanayake, and N. Nicholson (2003), Wide Area DGPS Performance Analysis, **Proceedings of the CASI Conference**, Ottawa, April 28-30.

Sneeuw, N. (2003), LISA/Cartwheel Orbit Type for Future Gravity Field Satellite Missions, **Proceedings of the Weikko A. Heiskanen Symposium in Geodesy**, Columbus, OH, October 1-4, CD.

Stirling, R., J. Collin, K. Fyfe, and G. Lachapelle (2003), An Innovative Shoe-Mounted Pedestrian Navigation System, **Proceedings of GNSS 2003, The European Navigation Conference**, Graz, Austria, April 22-25, CD.

Teskey, W. F. and R.J. Fox (2002), Use of GPS for Determining Free Flight Performance, **Proceedings of the 22nd International FIG Congress**, Washington, D. C., April 19-26, pp. 20-27.

Vergos, G.S. and M.G. Sideris (2002), Improving the estimation of the bottom ocean topography with altimetry derived gravity data using the integrated inverse method, **Proceedings of the 2001 International Association of Geodesy Scientific Assembly**, IAG Symposia Vol. 125 - Vistas for Geodesy in the New Millennium (J. Adam, K.P. Schwarz, Eds.), Budapest, Hungary, September. 2-7, 2001, pp. 529-534. Springer-Verlag Berlin Heidelberg New York.

Vergos, G.S., F.A. Bayoud, M.G. Sideris, and I.N. Tziavos (2002), High-resolution geoid computation by combining shipborne and muti-satellite altimetry

data in the eastern Mediterranean Sea, **Proceedings of the XXVI General Assembly of the European Geophysical Society** (I.N. Tziavos and R. Barzaghi, Eds.), March 25-30, 2001, Nice, France. Special Issue of IGeS Bulletin Vol. 13, pp. 85-99.

Vergos, G.S., R.S. Grebenitcharsky, and M.G. Sideris (2002), Combination of multi-Satellite altimetry and shipborne gravity data for geoid determination in a coastal region of eastern Canada, **Proceedings of the XXVI General Assembly of the European Geophysical Society** (I.N. Tziavos and R. Barzaghi, Eds.), March 25-30, 2001, Nice, France. Special Issue of IGeS Bulletin Vol. 13, pp. 100-115.

Wang, C. and G. Lachapelle (2002), GPS Attitude Determination Reliability Performance Improvement Using Low Cost Receivers, **Proceedings of ION GPS 2002**, Portland, OR, September 24-27, pp. 1064-1074.

Williams, F.M., M. Klawe, M.E. Cannon, C. Deschênes, M. Frize, and B. Muir (2002), The NSERC/Industry Chairs for Women in Science and Engineering: A National Program in Canadian Universities, **Proceedings of ICWES12 Conference**, Ottawa, ON, July-25-31, CD.

Zhang, X. and M.E. Cannon (2002), Integration of GPS with a Medium Accuracy INS for Meter-Level Positioning Using a Wave Estimator, **Proceedings of the ION Annual Meeting**, Albuquerque, June 24-26, pp. 241-249.

Scholarly Presentations and Seminars

Aguirre-Martinez, M. and N. Sneeuw (2002), Needs and Tools for Future Gravity Measuring Missions, ISSI Workshop on Earth Gravity Field from Space, Berne, Switzerland, March 11-15.

Blais, J.A.R. (2002), Estimation and Spectral Analysis. Twelve graduate lectures at the Chongqing University of Posts and Telecommunication, Chongqing, China, Oct. 12-Nov. 20.

Blais, J.A.R., D.A. Provins and M.A. Rajabi (2002), Challenges in Advanced Geocomputations and Visualization, Oral presentation at the Annual Meeting of the Canadian Geophysical Union in Banff, AB, May 18-21.

Bouman, J., R. Koop, and N. Sneeuw (2002), Internal and External Error Assessment of goce Gradiometric Data, AGU 2002 Fall Meeting, San Francisco, December 6-10.

Cannon, M.E. (2002), Advances in Geomatics as They Apply to Transportation, CTEP Commercial Vehicle Operations Seminar, Calgary, November 20.

Cannon, M.E. (2002), Bringing Space Down to Earth - Using Satellites to Navigate in the 21st Century, University of Victoria, December 2.

Cannon, M.E. (2002), Construction of an Integrated Navigation Information Infrastructure, Auto21 Scientific Conference, Toronto, September 26-28.

Cannon, M.E. (2002), Using the Global Positioning System (GPS) to Support Georeferencing Applications, Department of Geography, University of Calgary, November 1.

Cannon, M.E. and K. Scherf (2002), Women in Science and Communication – Synergies for the Future, New Media Career Accelerator, Banff, March 8.

Cannon, M.E. and G. Lachapelle (2002), Geomatics Engineering GNSS Capabilities. Presented to Thales ATM GmbH Visiting Team, Calgary, June 11.

Dogan, U., G. Lachapelle, H. Dermirel, and S. Ergintav (2002), How Did 3-Dimension Transformation Parameters Change in Marmara Region after the 17th August 1999 Izmit, Turkey Earthquake? CGU Annual Meeting, Banff, May 18-21.

Dogan, U., G. Lachapelle, S. Ergintav, and H. Dermirel (2002), Tectonic Move-

ments Monitoring of North Anatolian Fault in Marmara Region Using GPS Baselines, CGU Annual Meeting, Banff, May 18-21.
El-Sheimy, N. (2002), GPS/INS Integration for Positioning and Navigation Application, Invited course, Technical University of Vienna, Austria, December.
El-Sheimy, N. (2003), Integrated Navigation Systems, Invited course, Electronics Engineering, Autoflug GmbH, Germany, March.
El-Sheimy, N. (2002), Mobile Mapping Technologies, Invited course, Ain Shams University, Cairo, Egypt, December.
El-Sheimy, N. (2003), Trends in GPS/INS Integration for Surveying and Mapping Applications, Canadian Aeronautics and Space Institute AGM50, Montreal, April.
Gao, Y. (2002), Advances in Differential GPS, GPS Development and Application Workshop, Beijing, China, November 11.
Habib, A.F. (2002), Automatic Co-registration and Change Detection between Multiple Datasets, 2002 Fall Conference of Korean Society for Geo-Spatial Information System, Seoul, Korea, November 11 (35 Participants, 45 minutes)
Habib, A.F. (2002), GIS and Photogrammetry: The Impact of New Sensors/Systems, The 7th International Seminar & Workshop on GIS, Seoul, Korea, November 8, (200 Participants, 45 minutes)
Habib, A.F. (2002), Introduction to Geomatics Engineering: The Mobile Mapping System Application, Department of Civil Engineering, Yonsei University, Korea, November 12, (30 Participants, 50 minutes)
Kent, S., M.A. Rajabi, and J.A.R. Blais (2002), Uncertainty and Reliability in Geospatial Information Systems, Poster presentation at the Annual Meeting of the Canadian Geophysical Union in Banff, AB, May 18-21.
Kern, M., N. Sneeuw, and K.P. Schwarz (2002), A Study on the Combination of Satellite, Airborne and Terrestrial Gravity Data, Meeting of the European Geophysical Society 2002, Nice, France, March 25-30.
Kotsakis, C (2002), Improving the Agreement Between Gravimetric and GPS/Leveling Geoids with a Non-Rigid Similarity Transformation Model, Presented at the 3rd Meeting of the International Gravity and Geoid Commission, Thessaloniki, Greece, August 26-30.
Lachapelle, G. (2002), Geomatics Engineering - A Passion for Excellence, Presented to Visiting Group of Potential Donors to the University of Calgary, June 19.
Lachapelle, G. (2002), Geomatics Engineering Education and Research Programme Overview, Invited Presentation, Ecole Polytechnique Fédérale, Lausanne, December 18.
Lachapelle, G. (2002), Geomatics Engineering Overview and GNSS Capabilities, Presented to Leica Switzerland and Ordnance Survey Visiting Team, Calgary, July 3.
Lachapelle, G. (2002), GNSS Opportunities and Challenges. Keynote Address, GNSS02 Conference, Wuhan, China, November 6-8.
Lachapelle, G. (2002), GPS and GPS/INS R&D Activities, Invited Presentation, JPALS Program Meeting, Shell Beach, CA, December 9-10.
Lachapelle, G. (2002), GPS Signal Availability Indoor and in Urban Canyons, Invited Presentation, University of Sao Paulo, September 17.
Lachapelle, G. (2002), Overview of Wireless Location Methods, Invited Presentation, GNSS02 Conference, Wuhan, China, November 6-8.
Lachapelle, G. (2002), Positioning, Location and Navigation. Presented at Geomatics Engineering Industry Day, University of Calgary, May 10.

Lachapelle, G. (2002), Wireless Location - A Technology Status, Invited Presentation, Chongquig University of Post and Telecommunication, China, November 9.

Lachapelle, G. (2002), Wireless Location Research Group GNSS Research, Development and Testing Capabilities, Presentation to Nokia-WLRG Meeting, Calgary, December 9.

Lachapelle, G. (2002), Wireless Location, Positioning and Navigation Activities at the University of Calgary, Invited Presentation, University of Sao Paulo, September 16.

Lachapelle, G. and M.E. Cannon (2002), University of Calgary GNSS R&D and Testing Capabilities, Invited Presentation, Canada/USA/UK/Australia NavWar Meeting, Ottawa, June 21.

Lachapelle, G. and K. O'Keefe (2002), Impact of Galileo on User's Performance, Invited Presentation, U.S. Air Force Institute of Technology, Wright-Patterson AFB, Ohio, October 6.

Losch, M., B. Sloyan, J. Schroeter, and N. Sneeuw (2002), Box Inverse Models of the Ocean Circulation, Altimetry and the Geoid: Problems with the Omission Error, Meeting of the European Geophysical Society 2002, Nice, France, March 25-30.

MacGougan, G., G. Lachapelle, and M.E. Cannon (2002), The STR4760 Simulator Research Tool at the University of Calgary. Presented at Spirent Federal Systems GPS Users Group Meeting, Houston, TX, June 11-13.

Raaflaub, L. and M.J. Collins (2002), The Effect Errors in Gridded Digital Elevation have on Derived Topographic Parameters Using Monte Carlo Simulation: A Comparison of Algorithms, Poster Presentation at the 5th International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences, Melbourne, Australia, July 10-12.

Raaflaub, L. and M.J. Collins (2002), The Effect Errors in Gridded Digital Elevation have on Derived Topographic Parameters Using Monte Carlo Simulation: A Comparison of Algorithms, Poster Presentation at the International Geoscience and Remote Sensing Symposium, Toronto, ON, June 24-28.

Raaflaub, L. and M.J. Collins (2002), The Effect Errors in Gridded Digital Elevation have on Derived Topographic Parameters Using Monte Carlo Simulation: A Comparison of Algorithms, Poster Presentation at FIG 2002 XII International Congress, Washington, DC, April 19-26.

Raaflaub, L., M.J. Collins, R. Quinonez-Pinon, and C. Valeo (2002), The Effect of Errors in Gridded Digital Elevation Data on the Distributed Hydrological model TOPMODEL, Poster Presentation at the 5th International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences, Melbourne, Australia, July 10-12.

Raaflaub, L., M.J. Collins, R. Quinonez-Pinon, and C. Valeo (2002), The Effect of Errors in Gridded Digital Elevation Data on the Distributed Hydrological model TOPMODEL, Poster Presentation at the International Geoscience and Remote Sensing Symposium, Toronto, ON, June 24-28.

Raaflaub, L., M.J. Collins, R. Quinonez-Pinon, and C. Valeo (2002), The Effect of Errors in Gridded Digital Elevation Data on the Distributed Hydrological model TOPMODEL, Poster Presentation at FIG 2002 XII International Congress, Washington, DC, April 19-26.

Rajabi, M.A. and J.A.R. Blais (2002), Digital Terrain Model Densification Using Single Satellite Imagery, Poster presentation at the Annual Meeting of the Canadian Geophysical Union in Banff, AB, May 18-21.

Rajabi, M.A., D.A. Provins and J.A.R. Blais (2002), Applications of Hierarchical Data Format in Geoscience, Poster presentation at the Annual Meeting of the Canadian Geophysical Union in Banff, AB, May 18-21.

Rakai, M.E. (2002), Towards a Multicultural Land Tenure Model for Cross-cultural Tenure Systems, Paper presented at XXII FIG (International Federation of Surveyors) Conference, Washington D.C., April (25 participants, 30 minutes).

Skone, S. (2002), GPS as a remote sensing tool for atmospheric science, Korea Astronomy Observatory, Daejeon, Korea, December 10.

Skone, S. (2002), GPS Meteorology - Status and Potential Applications, Korea Meteorological Association, Seoul, Korea, December 12.

Skone, S. (2002), Strategies for Real-time Modeling of Water Vapour and Wet Refractivity using GPS, Korea Astronomy Observatory, Daejeon, Korea, December 10.

Skone, S. (2003), GPS Meteorology, Presented at the Canadian Meteorological and Oceanographic Society Alberta Chapter Meeting, Edmonton, AB, February 27.

Skone, S. (2003), GPS Meteorology, Presented at the Canadian Meteorological and Oceanographic Society Alberta Chapter Meeting, Calgary, AB, February 18.

Skone, S. (2003), Hydrography, Presented at HMCS Tecumseh, Calgary, January 15.

Skone, S. and S.M. Shrestha (2003), 4-D modeling of Water Vapour using a Regional GPS Network, Presented at the Institute of Navigation National Technical Meeting 2003, Anaheim, CA, January 22-24.

Skone, S. and S.M. Shrestha (2002), Strategies for Real-time Regional Modeling of Water Vapour using GPS, 2002 International Symposium on GPS/GNSS, Wuhan, China, November 6-8.

Sneeuw, N. (2002), Space-wise, Time-wise, Torus and Rosborough Representations in Gravity Field Modelling, ISSI Workshop on Earth Gravity Field from Space, March, Berne, Switzerland March 11-15.

Sneeuw, N. (2003), Global Geophysical Fluids: Gravitational Detection from Space, Biogeoscience Seminar Series, University of Calgary, March 13.

Sneeuw, N. and P. Wu (2002), Global Gravity Field Satellite Missions - Implications for Geoscience Research in Canada, Meeting of the Canadian Geophysical Union 2002, Banff, AB, May 18-21.

Sneeuw, N., C. Gerlach, D. Svehla, and C. Gruber (2002), A First Attempt at Time-variable Gravity Recovery from CHAMP using the Energy Balance Approach, 3rd Gravity and Geoid symposium, Thessaloniki, August 26-30.

Sneeuw, N., C. Gerlach, P. Visser, D. Svehla, and C. Gruber (2002), CHAMP, First Results with the Energy Balance Approach, Meeting of the Canadian Geophysical Union 2002, Banff, AB, May 18-21.

Tocho, C., M.G. Sideris, and G. Font (2002), Different Topographic Reduction Methods in Practical Gravimetric Geoid Determination, Presented at the Argentinean Association of Geodesists and Geophysicists Annual Meeting, Rosario, Santa Fe, Argentina, Sept. 23-27.

Valeo, C. (2002), Remote Sensing for Hydrology: Summary and Most Significant Research in last 20 years", Lecture to the IAHS Hydrology 2020 Working Group, Paris, France, June 13-15.

Valeo, C. (2002), The Application of GIS and Remote Sensing for Hydrological Modelling in Remote Regions, Lecture in The Advanced Training Course on Watershed Flood Control and Management at Wuhan University, Wuhan, China,

July 8 - 12,CIDA-UPCD Tier 2 Project.

Valeo, C. (2002), Variable Source Area Modelling in Urbanizing Catchments and Determining Precipitation Length Scales, Lecture in The Advanced Training Course on Watershed Flood Control and Management at Wuhan University, Wuhan, China, July 8 - 12, CIDA-UPCD Tier 2 Project.

Vergos, G.S. and M.G. Sideris (2002), Gravity Field and Quasi-stationary Sea Surface Topography Estimation using Heterogeneous Data, 28th Annual meeting of the CGU, Banff, Alberta, May 18-21.

Vergos, G.S. and M.G. Sideris (2002), Marine Geoid Estimation using Satellite and Shipborne Data, 28th Annual meeting of the CGU, Banff, Alberta, May 18-21.

Visser, P., N. Sneeuw, and C. Gerlach (2002), Energy Integral Method for Gravity Field Determination from Satellite Orbit Coordinates, Meeting of the European Geophysical Society 2002, Nice, France, March 25-30.

Technical Reports and Notes

Cannon, M.E., G. Lachapelle, O. Julien, W. Zhang, V. Kubacki, K. O'Keefe, and P. Alves (2002), Galileo System Analysis Report for the Canadian Region A,Galilei Phase. Prepared for Canadian Space Agency {CSA Report No. CSA-ST-CR-2002-0070 (Volume 2 of 2)}.

Cannon, M.E., G. Lachapelle, and T. Murfin (2002), Establishment of a Canadian Centre of Innovation in Global Navigation Satellite Systems (GNSS) at the University of Calgary, Final Contract Report to the Canadian Space Agency, 47 pp.

Cannon, M.E., W. Zhang, and L.P.S Fortes (2002), Airborne Data Processing Using the MultiRef Method in Post-Mission, Final Contract Report to Applanix Corp., October, 83 pp.

Gao, Y., X. Shen, K. Chen, and M. Abdel-Salam (2002), Investigation on Single Point Positioning with real-Time GPS*C Data, Contract report for Natural Resources Canada, The Department of Geomatics Engineering, The University of Calgary, Alberta.

Habib, A. and M. Morgan (2002), Epipolar Image Resampling from Push-Broom Imagery: Investigation and Preliminary Implementation, project report submitted to the Korean Electronics and Telecommunications Research Institute (ETRI).

Lachapelle, G., G. MacGougan, K. O'Keefe, and M. Petovello (2002), Testing of the Force 22 GPS Receiver. Report prepared for Defence Research Establishment Ottawa, Department of National Defence

Lachapelle, G., M.E. Cannon, R. Klukas, and G. MacGougan (2002), Report on GPS Signal Degradation Simulation Test Procedures and Results (Testing of the Trimble Force 22 and Novatel OEM4 Receivers) for Department of National Defence, Defence Research Establishment Ottawa.

Lachapelle, G., M.E. Cannon, R. Klukas, O. Julien, and L. Dong (2002), Performance Testing of UHF/CDMA Technologies for A Tactical Indoor Positioning System. Report prepared for Defence Research Establishment Ottawa, Department of National Defence, 100 pp.

Skone, S., Y. Moon, and V. Hoyle (2003), Evaluation of Interpolation Methods for Real-Time Estimation of Ionospheric Vertical Delays Using Dual-Frequency GPS Observations from RTCACS Wide-Area Network, contract report for Natural Resources Canada, March 31, 56 pages.

Technology Transfer (New and Ongoing)

Cannon, M.E. and G. Lachapelle, HEADRT+™ - software package for GPS heading and pitch determination. Licensed by UTI Inc.

Petovello, M., M.E. Cannon, and G. Lachapelle (2002) SAINT™ Satellite And Inertial Navigation Technology Software Licensed by University Technologies International.

Cannon, M.E., G. Lachapelle, J. Liu, FLYKIN^{+}™ - software package for cm-level GPS on-the-fly ambiguity resolution positioning. Licensed by UTI Inc.

Cannon, M.E.,G. Lachapelle and M. Petovello, C3NAVG2™ - Combined Code and Carrier for NAVigation using GPS and GLONASS, a software package for differential kinematic positioning at the 1-3 m level. Licensed by UTI Inc.

Ellum, C. and N. El-Sheimy (2001-2002): BUNDLE Software, Bundle is software package that performs self-calibrating photogrammetric Bundle™ adjustments and terrestrial network adjustments.

Lachapelle, G., and M.E. Cannon (2003MultiRef™) software for multiple reference stations Real-Time Kinematic GPS application. Developed in cooperation with Roberton Enterprises Ltd, Calgary, and licensed by University Technologies International, a wholly-owned subsidiary of the University of Calgary.

Schwarz, K.P. and N. El-Sheimy (1998-2002): KINGSPAD (KINematic Geodetic System for Positions and Attitude Determination) Software.

Other (Interviews, Newsletters)

Cannon, M.E.
- QR77, March 9, 5 minutes – Steacie Award
- QR77, March 11, 5 minutes, Steacie Award
- Business Edge, March 14 edition
- Industry Canada video, January, U of C
- NSERC, Steacie News release – Calgary Sun, Gazette
- U of A Student newspaper, GATE, March 25
- U of C Alumni Magazine, Summer 2002 edition, GPS research
- Gazette, December 16 edition – TUFCA Award and Steacie CFI

El-Sheimy, N. User Manual of the KINGSPAD (KINematic Geodetic System for Positions and Attitude Determination) Software

Kotsakis, C. (2003), Book Review, "Grochenig, K.: Foundations of Time-Frequency Analysis, 359 pp., 15 figs., Birkhauser, Boston, 2001, ISBN 0-8176-4022-3", published in IAG Newsletter, Journal of Geodesy, Vol. 76, No. 9-10, pp. 588-589.

Lachapelle, G. and J. WANG (2002) Letter from the Guest Editors: The GPS Wireless Special Issue, GPS Solutions, 6, 3, 137-137.

Lachapelle, G. and P. ALVES (2002) Multiple Reference Station Approach: Overview and Current Research. Invited Contribution, Export Forum on VRS, Journal of Global Positioning Systems, 1, 2.

Lachapelle, G., Business Edge, Wireless business (Lisa Dempster, Journalist)

Valeo, C. (2002), Hydrology 2020 Working Group, IAHS Newsletter, No. 4, April.

Theses

El-Gizawy, M.L. (2003), Development of an Ionosphere Monitoring Technique Using GPS Measurements for High Latitude GPS Users, MSc Thesis, Report No. 20171, Department of Geomatics Engineering, University of Calgary.

Ho, C.L.I. (2002), Urban Snow Hydrology and Modelling, MSc Thesis, Report No. 20169, Department of Geomatics Engineering, University of Calgary.

Hunter, A.J.S. (2002), Mobile GIS as if Field Users Mattered: Small is Ubiquitous but can Speech be Recognized?, MSc Thesis, Report No. 20165, Department of Geomatics Engineering, University of Calgary.

Kennedy, S.L. (2002), Acceleration Estimation from GPS Carrier Phases for Airborne Gravimetry, MSc Thesis, Report No. 20160, Department of Geomatics Engineering, University of Calgary.

Kern, M. (2003), An Analysis of the Combination and Downward Continuation of Satellite, Airborne and Terrestrial Gravity Data, PhD Thesis, Report No. 20172, Department of Geomatics Engineering, University of Calgary.

Liu, J. (2003), Implementation and Analysis of GPS Amiguity Resolution Strategies in Single and Multiple reference Station Scenarios, MSc Thesis, Report No. 20168, Department of Geomatics Engineering, University of Calgary.

Liu, Z. (2002), A Java-Based Wireless Framework for Location-Based Services Applications, MSc Thesis, Report No. 20161, Department of Geomatics Engineering, University of Calgary.

Olynik, M.C. (2002), Temporal Characteristics of GPS Error Sources and their Impact on Relative Positioning, MSc Thesis, Report No. 20162, Department of Geomatics Engineering, University of Calgary.

Petovello, M.G. (2003), Real-time Integration of a Tactical-Grade IMuy and GPS for High-Accuracy Positioning and Navigation, PhD Thesis, Report No. 20173, Department of Geomatics Engineering, University of Calgary.

Raaflaub, L.D. (2002), The Effect of Error in Gridded Digital Elevation Models on Topographic Analysis and on the Distributed Gydrolgoical Model TOPMODEL, MSc Thesis, Report No. 20163, Department of Geomatics Engineering, University of Calgary.

Radovanovic, R.S. (2002), Adjustment of Satellite-Based Ranging Observations for Precise Positioning and Deformation Monitoring, PhD Thesis, Report No. 20166, Department of Geomatics Engineering, University of Calgary.

Ryan, S.J. (2002), Augmentation of DGPS for Marine Navigation, PhD Thesis, Report No. 20164, Department of Geomatics Engineering, University of Calgary.Shahriari Namini, N. (2002), A new Approach for Simplification of Linear Vector Dada for Internet-based GIS Applications, MSc Thesis, Report No. 20167, Department of Geomatics Engineering, University of Calgary.

Shen, X. (2002),Improving Ambiguity Convergence in Carrier Phase-based Precise Point Positioning, MSc Thesis, Report No. 20170, Department of Geomatics Engineering, University of Calgary.

Geomatics Engineering Theses are now available in their entirety at http://www.geomatics.ucalgary.ca/GradTheses.html

ACADEMIC AND PROFESSIONAL SERVICES

M.B. Barry

- Vice President, Council of the Institute of Professional Land Surveyors and Geomaticians of the Western Cape. South Africa
- South African Qualifications Authority (SAQA) 2002. Member and small group leader on generating unit standards for education in geographic information science in South Africa
- FIG Working Groups; Member WG 4.3 on Marine Cadastre; Advisor WG 7.1 Creating Land Administration in formal and informal environment; Advisor WG7.2 Instruments for land distribution
- Reviewer for International Journal of Geographic Information Science
- Reviewer for Geomatica
- Reviewer for Survey Review

M.E. Cannon

- Member, Academic Plan Advisory Group
- Chair, Geomatics Canada Technical Advisory Committee
- Director, Alberta Research Council
- Member, NSERC Committee on Research Partnerships
- Member, NSERC Reallocations Committee
- Member, Alberta Science and Research Authority (ASRA) Board of Management
- Director, Calgary Science Centre
- Trustee, Alberta Ingenuity Fund
- Director, Top 40 Under 40 Board
- Editorial Board, GPS Solutions

M.J. Collins

- Associate Head Undergraduate Studies
- Member, Faculty of Engineering, Undergraduate Studies Committee
- Member, Teaching Development Committee of the Learning Commons
- Reviewer for three technical journals
- APEGGA, Board of Examiners
- Canadian Remote Sensing Society Certification Board
- Associate Editor, International Journal of Remote Sensing

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- Member, European Association of Remote-Sensing Laboratories
- Member, EuroSDR Working Group
- Member, Faculty of Engineering High School Liaison Committee
- Member, Faculty of Engineering Gender and Diversity Committee
- Member, Department Advisory Selection Committee (Photogrammetry position)
- Reviewer, Photogrammetric Engineering and Remote Sensing (PE&RS) Journal, IJRS, CJRS, Bulletin SEPT
- Member, NCE Geoide Network

N. El-Sheimy

- Associate Head Undergraduate Studies (July 1, 2002)
- Chair, International Association of Geodesy (IAG) Special Working Group SC4-WG1 on Mobile Multi-Sensor Systems
- Chair, International Federation of Surveyors (FIG) working group C5.3 on Integrated Positioning, Navigation and Mapping Systems
- Member, Steering Committee of the International Federation of Surveyors (FIG) Commission 5

- Technical Program Co-Chair and Member, Organizing Committee for a number of international conferences on Real-time Mobile Mapping Systems
- Member, International Society of Photogrammetry and Remote Sensing WGII-1 Real-time Mobile Mapping Systems
- Member, Alberta Geomatics Group Board of Directors
- Special Examiner, Board of Examiners for Canada Land Surveyors
- Member, Editorial Board of the UK, Survey Review Journal

Y. Gao

- President, International Association of Chinese Professionals in Global Positioning Systems
- Member, IAG SSG1.179
- Co-chair, FIG C5-3 Working Group - Kinemantic and Integrated Positioning
- Member, Faculty of Engineering Internship Standing Committee and Internship Advisory Council
- Member, Faculty of Engineering Student Appeals Committee
- Department Representatiave, TUCFA
- Special Examiner, Board of Examiners for Canada Land Surveyors
- Editorial Board, Journal of Geographic Information Science
- Editorial Board, Journal of Global Positioning Systems
- Program Chair, 2002 International Symposium on GPS/GNSS

A.F. Habib

- Co-Chair, ISPRS Working Group III/1 (Sensor Pose Estimation)
- Member, American Society for Photogrammetry and Remote Sensing
- Member, steering committee for the First International Workshop on Future Intelligent Earth Observing Satellites (FIEOS)
- Member, ΦΚΦ Honor Society and S X scientific society
- Reviewer, Journal of Photogrammetric Engineering and Remote Sensing
- Reviewer, Geomatica Journal
- Reviewer, John Wiley & Sons, Inc and ASPRS publishing
- Member and reviewer, Program Committee for the ISPRS Commission III symposium “Photogrammetric Computer Vision”, Graz, Austria
- Session chair/moderator for several ISPRS conferences and symposia

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- Member of the International Society of Surveyors (FIG), Working Group C5-1 on Integrated Positioning and Navigation Systems
- Associate Editor for IEEE Transactions on Vehicular Technology
- Reviewer for GPS Solutions

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- AssociateMember, International Association of Geodesy (IAG)
- Member, IAG Special Study Group on Regional and Marine Geoid Modelling
- Member, IAG Special Study Group on Wavelets in Geodesy and Geodynamics

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- Member of the Canadian Geophysical Union, Ekuropean Geophhysical Society, American Geophysical Union and the Alberta Geomatics Group
- Member, Technicl Chamber of Greece
- Member, Member, Hellenic Association of Professional Surveying Engineers
- Reviewer for Journal of Geodesy, IgeS Bulletin, Physics and Chemistry of the Earth, IAG Proceedings Serices

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- Chair, Institute of Navigation Alberta Chapter
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- Management Team, Calgary Centre for Innovative Technology
- Editorial Board, GPS World
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- General Chair, ION GPS 2002
- Board of Directors, University Technologies International

- Member, Internship Committee **M.E. Rakai**
- Member, Geomatics Engineering Liaison Committee
- Member, Professional Development Committee, Alberta Land Surveyors Association (ALSA)
- Member, Western Canadian Board of Examiners Committee
- Member, International Federation of Surveyors (FIG) Commission 7 Working Group 7.1: Creating Land Administration in formal and informal environment
- Associate Member, New Zealand Institute of Surveyors

- Associate Dean (Research), Faculty of Engineering **M.G. Sideris**
- Chair, Research and Post Graduate Studies Committee of the Faculty of Engineering
- Member, UofC Strategic Resarch Plan Working Group
- Member of several committees and forums of the University of Calgary, Faculty of Engineering and the FAculty of Graduate Studies
- Member, Board of Directors of ASTech and of the Bureau Gravimetrique International
- Member, Executive Committee, International Association of Geodesy (IAG)
- President, IAG Section III: Determination of the Gravity Field
- Member of several IAG special study groups, commissions, and working groups
- Member, Research Management Committee, Geomatics for Informed Decisions (GEOIDE) Network Centres of Excellence (NCE)
- Reviewer for the Journal of Geodesy and for Geomatics

- Associate Head, Graduate Studies **S.H. Skone**
- Research and Post-Graduate Studies Committee
- FGS Policy Committee
- Lead co-investigator: CHAMP satellite mission

- Chair, Canadian Navigation Society
- Co-Chair IAG SSG 1.180, GPS as an Atmospheric Remote Sensing Tool
- Corresponding member IAG SSG 1.181, Regional Permanent Arrays
- Associate Editor, Canadian Aeronautics and Space Institute Journal
- Reviewer for numerous international journals

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- Chair, International Association of Geodesy (IAG) Special Study Group SSG3.185: Merging Data from Dedicated Satellite Missions with Other Gravimetric Data
- Member, International Association of Geodesy (IAG) Special Commission SC-1: Mathematical and Physical Foundations of Geodesy
- Member, IAG/IGGC/IGeS Working Group: Preparation of Standard Procedures for Global Gravity Field Validation
- Member, International Association of Geodesy (IAG), Planning Committee for the Intercommission Committee on Theory
- Member-at-large, Geodesy Section Executive Committee, Canadian Geophysical Union
- Member, University Research Grants Committee
- Member, High School Liaison Committee
- Reviewer for Journal of Geodesy

M.P. Tait

- APEGGA Essay competition judge
- Vice-Chairman, Calgary CIG Branch
- Member, Remote Sensing and Photogrammetry Society, UK
- Member, Gender and Diversity Committee
- Member, Internship Committee
- Co-organizer, Geomatics Engineering Industry Day

W.F. Teskey

- Member, Academic Awards Committee, University of Calgary
- Co-Chair, Faculty of Engineering Academic Appeals Committee
- Canadian representative to Commission 6 (Engineering Surveys) of the International Federation of Surveys (FIG)
- Member, Western Canadian Board of Examiners for Land Surveyors
- Academic Examiner for Geomatics Engineering, APEGGA
- Member, Publications Committee, Journal of Surveying Engineering

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- Member, Research & Post-Graduate Studies Committee
- Member of Canadian Water Resources Association
- Member, Faculty of Engineering, Engineering for the Environment
- Reviewer for Hydrological Processes
- Member of the Canadian Geophysical Union
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