



1. Two examples of terrestrial reference standard sites used for post-launch satellite sensor radiometric calibration (Tuz Golu salt lake in Turkey on the left and the Gobi desert near Dunhuang in China on the right)
2. Prototype of field-portable instrument for real-time high-accuracy measurements of greenhouse gases such as N₂O, CO₂, and CH₄
3. Roof-top solar radiometer at the University of Lethbridge, a node of Canada's aerosol monitoring network (AEROCAN), which is a federated component of the world-wide aerosol robotic network (AERONET) operated by the NASA Goddard Space Flight Center
4. Group photo, 21st Meeting of the international Infrared Visible Optical Sensors (IVOS) Subgroup, Working Group on Calibration and Validation (WGCV), Committee on Earth Observation satellites (CEOS), hosted by the University of Lethbridge, August 2009
5. Three-channel laser spectrometer for laboratory spectroscopy of molecules of terrestrial and planetary atmospheres
6. Editors-in-Chief from the International Remote Sensing Publication Forum held at the 30th Canadian Symposium on Remote Sensing, University of Lethbridge, June 2009: (left to right) Christopher Ruf, IEEE TGARS; Ellsworth LeDrew, IEEE JSTARS; Gilles Foody, IJRS; Nicholas Coops, CJRS; Marvin Bauer, RSE; Russell Congalton, PE&RS; Symposium Chair Derek Peddle (far right)
7. Detection of keystone effect in imaging spectrometer data: results for the Earth Observing-1 Hyperion sensor in terms of spatial shift relative to reference spectral band 120



Information Contact

Dr. Philippe M. Teillet
Department of Physics and Astronomy
University of Lethbridge
4401 University Drive W.
Lethbridge, Alberta T1K 3M4
Canada
p.teillet@uleth.ca

Overview

Introduction

The Remote Sensing Group (RSG) at the University of Lethbridge (UL) is composed primarily of faculty, students and other researchers from the Department of Geography and the Department of Physics and Astronomy, Faculty of Arts and Science. The RSG also collaborates with imaging scientists at the UL in the fields of astronomy, medical imaging, image processing/computer science, and kinesiology.

Primary Research Areas

- Analysis of atmospheric trace gases
- Atmospheric correction of satellite image data
- Autonomous systems in support of post-launch satellite sensor calibration
- Bidirectional reflectance properties of Earth surfaces
- Development of remote sensing applications in agriculture, rangeland, forestry, mountainous terrain, oil sands, water resources, etc
- Hyperspectral imaging / imaging spectroscopy
- Image classification, texture analysis, and spectral mixture analysis
- Image processing and analysis methodologies
- Investigations of molecular structures
- Remote sensing laboratory and field analyses
- Remote sensing instrumentation (field/airborne/atmospheric sensors)
- Sensor radiometric calibration
- Topographic corrections of satellite image data
- Vegetation canopy reflectance modeling and inversion

Multi-Disciplinary Major in Remote Sensing

The University of Lethbridge has put in place a new Multi-Disciplinary Major in Remote Sensing, combining the strengths of the university's Department of Geography and Department of Physics and Astronomy. The program is designed to prepare B.Sc. graduates for a broad spectrum of job opportunities as well as graduate education and research.

Alberta Terrestrial Imaging Corporation

The UL RSG has a special relationship with the Alberta Terrestrial Imaging Corporation (ATIC), which is a partnership between the UL and Iunctus Geomatics Corporation, a Lethbridge-based company. ATIC is a non-profit applied research and development company that produces tools for optical remote sensing applications. It is involved in a variety of projects leading to technologies for image information extraction from hyperspectral and multispectral image data.

Remote Sensing Group

Faculty

Craig Coburn, Department of Geography
Derek Peddle, Department of Geography
Adriana Predoi-Cross, Department of Physics and Astronomy
Karl Staenz, Department of Geography
Phil Teillet, Department of Physics and Astronomy

Adjunct Professors

Department of Physics and Astronomy:
Brant Billingham, Canadian Light Source, Saskatoon, Saskatchewan
Per Jensen, University of Wuppertal, Wuppertal, Germany
Dionisio Bermejo, Instituto de Estructura de la Materia, Madrid, Spain
Department of Geography:
Ron Hall, Canadian Forest Service, Edmonton, Alberta
Anne Smith, Agriculture and Agri-Food Canada, Lethbridge, Alberta

Post-Doctoral Fellows

Zhijie Wang, Department of Physics and Astronomy

Research Assistants

Mark Gibb, Department of Geography
Aaron Glover, Department of Geography
Chris Jackson, Department of Geography
Julia Lindeman, Department of Geography
Kevin Nakonechny, Department of Geography
Xiaomeng Ren, Department of Physics and Astronomy
Shiyong Xu, Department of Geography

Graduate Students

Amr Ibrahim, Department of Physics and Astronomy
Deep Mazumdar, Department of Geography
Kean O'Shea, Department of Geography
Chad Povey, Department of Physics and Astronomy
Dave Rolfson, Department of Geography
Casey Vandenberg, Department of Geography

Undergraduate Research Assistants

Aaron Mullin, Department of Geography
Reba Murphy, Department of Physics and Astronomy
Steve Myshak, Department of Geography
Ryan Selk, Department of Geography
Brandon Southgate, Department of Geography
Alice Wismath, Department of Physics and Astronomy

Administrative Support

Dana Andrei, Margaret Cooke, and Sheila Matson, University of Lethbridge

Major R&D Funding Sources

Alberta Ingenuity New Faculty Award
Alberta Ingenuity Centre for Water Research
Canadian Foundation for Innovation Infrastructure Operating
Natural Sciences and Engineering Research Council of Canada Grants:
Discovery, Strategic, Research Capacity Development
University of Lethbridge Faculty of Arts and Science

Laboratories

The *Remote Sensing Laboratory* on the second floor of the Alberta Water and Environmental Sciences Building (AWESB) consolidates various elements of UL remote sensing research.

The *Remote Sensing Calibration Spectrometry Laboratory* is a highly specialized yet critical facility unique to Canada. The laboratory carries out spectroradiometric calibration of instrumentation used to support a variety of Earth and environmental science studies.

The *Atmospheric Spectroscopy Laboratory* on the seventh floor of University Hall undertakes laboratory spectroscopy of terrestrial and planetary atmospheric molecules. The main instrument is a three-channel home-made laser spectrometer, tuneable from 1.48 to 3.8 micrometers. A variable-temperature single-pass absorption gas cell was custom designed and built for the spectroscopic study of gases. This setup allows us to carry out highly sensitive line shape studies and fundamental spectroscopic studies of molecular interactions. Tuneable diode laser absorption spectroscopy has also been used to develop an instrument capable of high-accuracy measurements of greenhouse gases such as N₂O, CO₂, and CH₄. The field-portable instrument can be deployed in remote locations and used to measure greenhouse gas concentrations in real time.

Instrumentation

This suite of instrumentation is shared in part with ATIC

- AERONET/AEROCAN node Cimel CE-318 autonomous Sun-tracking photometer
- Airborne Multispectral Camera System
- ASD Field Spec spectrometers (3): 3 350-2500, 3 350-2500HR, and Pro 350-2500P
- ASD mercury argon calibration source assembly ALZSOLO
- ASD RTS-3ZC Reflectance/Transmittance Integrating Sphere
- Science mode Cimel CE-318 autonomous Sun-tracking photometer
- HEMI digital hemispherical photography system
- LAI-2000 plant canopy analyzer
- Pulnix AccuPiXEL cameras (6)
- SVC HR-1024 field spectrometer
- SWIR imaging spectrometer: Specim VN25E / MCT camera / Specim mirror scanner
- TRAC (Tracing Radiation and Architecture of Canopies) system
- Trimble TSCL and ProXRS DGPS receivers
- VNIR imaging spectrometers (2): Specim V10E / Hamamatsu C8484 / Specim mirror scanner
- Yankee Environmental Systems SPUV sun photometer

Field Goniometer System

The UL Goniometer System version 2 (ULGS-2) apparatus has a unique design that incorporates a number of advancements over other goniometers used to support remote sensing. The ULGS 2 uses a quarter circle positioning arc with a 2-m radius and no part of the apparatus touches the ground in the target area. This new design reduces the weight of the apparatus, increases portability, allows positioning over a wider variety of surfaces, and facilitates significantly faster data acquisition. ULGS-2 incorporates a computer-controlled motor-driven instrument payload that rapidly samples target bidirectional reflectance distribution functions.

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2009 Professional Activities, University of Lethbridge Remote Sensing Group

Conferences, Workshops and Specialist Meetings

- 1st Global Observation for Forest and Land Cover Dynamics (GOFC/GOLD) Biomass Working Group Meeting, Missoula, Minnesota
- 3rd International Spaceborne Imaging Spectroscopy (ISIS) Working Group Meeting, Tel Aviv, Israel
- 4th Meeting of the EnMAP Scientific Advisory Group, Geo-research Centre Potsdam, Potsdam, Germany
- 4th Canada-America-Mexico Graduate Student Physics Conference, Acapulco, Mexico
- 5th International Workshop on Infrared Microscopy and Spectroscopy with Accelerator Based Sources, Banff, Canada
- 5th Meeting of the EnMAP Scientific Advisory Group, Geo-research Centre Potsdam, Potsdam, Germany
- 6th EARSeL SIG Imaging Spectroscopy Workshop, Tel Aviv, Israel
- 11th Annual Scientific Conference, Geomatics for Informed Decisions (GEOIDE) Network, Vancouver, British Columbia
- 13th Annual Integrated Forest Pest Management Forum, Edmonton, Alberta
- 21st Colloquium on High-Resolution Molecular Spectroscopy, Castellamare di Stabia, Italy
- 21st Meeting of the Infrared Visible Optical Sensors (IVOS) Subgroup, Working Group on Calibration and Validation (WGCV), Committee on Earth Observation satellites (CEOS), Lethbridge, Alberta
- 30th Canadian Symposium on Remote Sensing, Lethbridge, Alberta
- 2009 Forest Pest Management Forum, Ottawa, Ontario
- 2009 HYSPIRI Science Workshop, NASA Jet Propulsion Laboratory (JPL), Pasadena, California, USA
- Agriculture and Agri-Food Canada Seminar Series, Lethbridge Research Centre, Lethbridge, Alberta
- American Geophysical Union (AGU) Fall Meeting, San Francisco, California, USA
- Canadian Light Source, Annual Users Meeting, Saskatoon, Saskatchewan
- Conference on Extending Forest Inventory and Monitoring over Space and Time, International Union of Forest Research Organizations (IUFRO) Division 4 on Forest Assessment, Modelling and Management, Quebec City, Quebec
- Inter-American Institute for Global Change Research International Summer School on Wireless Sensor Networks Workshop, University of Alberta, Edmonton, Alberta
- International GEO Workshop on Synthetic Aperture Radar (SAR) to Support Agricultural Monitoring Workshop, Kananaskis, Alberta
- Potato Growers of Alberta Annual General Meeting, Kananaskis, Alberta
- Saskatoon Synchrotron Summer School, Canadian Light Source, Saskatoon, Canada
- Southern Alberta Conservation Association Conference, Lethbridge, Alberta
- SPIE Conference on Sensors, Systems, and Next-Generation Satellites XIII, Berlin, Germany
- Women's Ways into Science: Lessons Learned and New Challenges for Gender Equality, Final Conference of the Practising Gender Equality in Science (PRAGES) Project, Rome, Italy

Service Activities and Memberships

- Alberta Geomatics Association
- American Society of Agronomy
- American Society of Photogrammetry and Remote Sensing
- Canadian Association of Geographers
- Canadian Association of Physicists
- Canadian Institute of Forestry
- Canadian Remote Sensing Society
- Canadian Society of Agronomy

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- Co-chair, IEEE International Spaceborne Imaging Spectroscopy (ISIS) Working Group
- College of Alberta Professional Foresters
- Editor, *Proceedings of the 5th International Workshop on Infrared Microscopy and Spectroscopy with Accelerator Based Sources*, American Institute of Physics
- Editors, *Proceedings of the 30th Canadian Symposium on Remote Sensing.*, Canadian Remote Sensing Society
- Editorial Board, *Canadian Journal of Forest Research*
- Editorial Board, *Canadian Journal of Remote Sensing*
- Editorial Board, *Remote Sensing of Environment*
- Editorial Board, *The Forestry Chronicle*
- Environmental Mapping and Analysis Program Scientific Advisory Committee (EnSAG) for a spaceborne hyperspectral mission, German Aerospace Centre, Germany
- Executive, Organizing and Technical Program Committees, 30th Canadian Symposium on Remote Sensing, Lethbridge, Alberta
- General Conference Chair, 30th Canadian Symposium on Remote Sensing, Lethbridge, Alberta
- Guest Editors, Special Issue: 30th Canadian Symposium on Remote Sensing, *Canadian Journal of Remote Sensing*
- IEEE Geoscience and Remote Sensing Society
- Organizing and Technical Program Committees, International GEO Workshop on Synthetic Aperture Radar (SAR) to Support Agricultural Monitoring Workshop, Kananaskis, Alberta
- Organizing Committee, 5th International Workshop on Infrared Microscopy and Spectroscopy with Accelerator Based Sources, Banff, Alberta
- President and Past-President, Canadian Remote Sensing Society
- Research Management Committee (RMC), Geomatics for Informed Decisions (GEOIDE) Centre of Excellence, Canadian Networks of Centres of Excellence (NCE)
- Secretary-Treasurer and Vice-President, Canadian Remote Sensing Society
- Society of Range Management
- Subgroup on Infrared-Visible Optical Sensors (IVOS), Committee on Earth Observation Satellites (CEOS) Working Group on Calibration and Validation
- Technical Program Committee, 2009 Congress of the Canadian Association of Physicists (CAP), Moncton, New Brunswick
- Technical Program Committee, 30th Canadian Symposium on Remote Sensing, Lethbridge, Alberta
- Technical Program Committee, SPIE Conference on Sensors, Systems, and Next-Generation Satellites XIII, Berlin, Germany
- Technical Program Committee, IEEE International Geoscience and Remote Sensing Symposium 2010, Cape Town, South Africa
- Technical Review Committee, Belgian Platform on Earth Observation, Space Research and Applications Division, Belgian Federal Science Policy Office, Brussels, Belgium

Courses Taught

- Department of Geography, University of Lethbridge
 - ◆ Advanced Computer Mapping, Geography 4700
 - ◆ Advanced Remote Sensing, Geography 4725/5725
 - ◆ Geographic Information Systems, Geography 3740
 - ◆ Independent Study: New Vegetation Indices. Geography 3990
 - ◆ Introduction to Geography, Geography 1010
 - ◆ Introduction to Remote Sensing, Geography 3720
 - ◆ Seminar in Remote Sensing, Geography 4753/5753
- Department of Physics and Astronomy, University of Lethbridge
 - ◆ Introduction to Physics II (Electricity and Magnetism), Physics 2000
 - ◆ Physics of Remote Sensing, Physics 4650/5650
 - ◆ Quantitative Spectroscopy for Atmospheric Remote Sensing, Physics 5850
 - ◆ Quantum Mechanics I, Physics 2150
 - ◆ Waves, Optics and Sound, Physics 2130

