GGR337H1F: Environmental Remote Sensing

Instructor: Alex Kalynchenko
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Teaching Assistants: Shadrova Anna anna.shadrova@mail.utoronto.ca
Xiong Dingyi (Alvin) alvin.xiong@mail.utoronto.ca

Lectures

Tuesday 12.00 - 14.00, Room SS 1070, Sidney Smith Hall, 100 St. George Street
Thursday 12.00 - 14.00, Room SS 1070

Please note that no audio or video recording is allowed at the lectures/labs unless approved by the course instructor.

Consultations

Instructor:
Tuesday 14.00 - 15.00, Room 5038 Sidney Smith Hall, 100 St. George Street
Thursday 14.00 - 15.00, Room 5038 Sidney Smith Hall

Please e-mail/notify me in advance to schedule an appointment.
TA office hours will be arranged during the first Lab.

Labs

Thursday 15.00 - 16.00 OR Thursday 16.00 - 17.00, Room 561 Lab, Sidney Smith Hall.
Except on May 23rd, on May 23rd location is at Carr Hall Lab. There are six labs in total.

Prerequisite

This course is offered to undergraduate students of diverse backgrounds, and does not require prior training in remote sensing. The emphasis of this course is on the basic concepts and skills in using remote sensing data.

Outline

Contemporary Environmental Remote Sensing (ERS) is an exciting composition of fundamental science, aero-space engineering, information technologies and state of the art techniques of image interpretation and analysis. Thanks to constellations of satellites and a fleet of aerial vehicles scanning the Earth surface in wide diapasons of electromagnetic spectrum, Remote Sensing became an integral part of environmental research and strategic decision-making locally, regionally and globally.

The course provides students with the foundations of remote sensing concept with focus on platforms ranging from quadcopters to high-altitude pseudosatellites and space satellites. The course will expose topics of electromagnetic radiation and its interaction with the Earth’s surface, satellite orbits, characteristics of optical and microwave sensors and environmental remote sensing applications. Students will acquire practical skills in image acquisition, analysis and thematic mapping, and learn the algorithm of searching for remote sensing data in the Big Data age.
Evaluation

4 Lab assignments 40%
Mid-term exam 15%
Group project 15%
Final exam 25%
Participation 5%

Late lab assignment submission will be penalized at 5% of the grade for each day of delay.

Text Books:


Additional resources:


Textbooks are available at Robarts Library on course reserve for short term loan. Some chapters may be available on Quercus. Supplementary resources relevant to the lecture topics will be provided in class and available via Robarts Library course reserve and on Quercus.

Course objectives

After successful completion of the course the students will be able to:

- Understand fundamental concepts of remote sensing, its modern trends and industries;
- Apply basic principles of electromagnetic radiation interaction with Earth surface to environmental research;
- Describe characteristics of air born and space born sensors, satellite orbits, key environmental satellites, and mainstream environmental applications of remote sensing to forestry, urban and regional planning, geology, hydrology, meteorology, oceanography, environmental assessment and natural disaster assessment;
- Practice remote sensing image interpretation and analysis with the use of spatial information system software;
- Apply knowledge, skills and the algorithm of search for remote sensing data in a stand-alone research project.

Please keep in contact with the Course Instructor and TAs regarding any questions you may have about the course.
## Course Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lectures</th>
<th>Labs</th>
<th>Readings</th>
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<tbody>
<tr>
<td>1</td>
<td>May 7</td>
<td>Foundations of remote sensing and its current state. Overview of the course.</td>
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<td></td>
<td>May 9</td>
<td>Electromagnetic radiation and spectrums. Optical, passive and active microwave sensors. Satellite types and orbits.</td>
<td>Lab. 1</td>
<td>RSII* Ch. 1. RSGIS** Ch. 1-3</td>
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<td>2</td>
<td>May 14</td>
<td>Multispectral, thermal and hyperspectral sensing. Principles of image acquisition and interpretation.</td>
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<td>RSII Ch. 4 RSGIS Ch. 7 Suggested list of topics for group projects</td>
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<td></td>
<td>May 16</td>
<td>Image interpretation and visual analysis. Digital processing.</td>
<td>Lab 2. Lab assignment 1 due</td>
<td>RSGIS Ch.10,11 Topic for group project approved by the Course Instructor</td>
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<td>3</td>
<td>May 21</td>
<td>Microwave and lidar remote sensing systems.</td>
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<td>RSII Ch. 6 (6.1-6.9, 6.15, 6.20-6.25) RSGIS Ch. 8</td>
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<td>May 23</td>
<td>Midterm Exam</td>
<td>Lab. 3 (Carr Hall Lab)</td>
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<td>4</td>
<td>May 28</td>
<td>Digital image interpretation and analysis (cont). Remote sensing in forestry and agriculture.</td>
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<td>RSII Ch. 7, 8.5, 8.4 RSGIS Ch.12 (pp.338-362)</td>
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<td></td>
<td>May 30</td>
<td>Remote sensing in geology, urban and regional planning. Mapping and digital elevation model.</td>
<td>Lab. 4 Lab assignment 2 due</td>
<td>RSII Ch. 8.3, 8.9, 8.15 RSGIS Ch. 12 (pp. 363-369, 405-413)</td>
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<td>5</td>
<td>June 4</td>
<td>Remote sensing in hydrology and water resource management.</td>
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<td>RSII Ch.8.7, 8.8</td>
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<td>June 6</td>
<td>Remote sensing in oceanography. Ocean and coastal monitoring. Wetland mapping. Natural disaster assessment.</td>
<td>Lab 5. Lab assignment 3 due</td>
<td>RSII Ch. 8.10 RSGIS Ch.12 (pp.370-375)</td>
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<td>6</td>
<td>June 11</td>
<td>Remote sensing in meteorology. Climate change monitoring. Earth observing system. Group presentations.</td>
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<td>RSII Ch. 5.14-5.19 RSGIS Ch. 12 Group project due</td>
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<td>June 13</td>
<td>Future of Environmental Remote Sensing. Course in review. Group presentations.</td>
<td>Lab 6. Lab assignment 4 due</td>
<td>Readings will be provided in class</td>
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<td>7</td>
<td>June 20</td>
<td>Final Exam</td>
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Group project (more details will be provided later in the course)

The group project will consist of group and individual components. You will be working in groups of 5-6 people throughout the duration of the course to produce the final group project PowerPoint presentation (PPT). Every member of the group is expected to contribute in meaningful way to the group effort. It will be your responsibility to coordinate the communication and work distribution on your team, to make sure you produce a good quality outcome. In the last lectures of the course your group will present the PPT to the class (15 min), and supply individual components online. Below are the general expectations from the assignment:

1. Define your area of research interests, state a problem, frame the scope of the problem and assume how remote sensing techniques can be used to help solve the problem.
2. Suggest specific remote sensing data applicable for the project with focus on spatial, temporal and radiometric resolution. Propose strategy for remote sensing data mining.
3. Locate and present appropriate images. Apply spatial information software techniques to address the problem.
4. Propose possible solutions/decisions. Elaborate on foreseeable challenges and costs.

As a result of this work, develop and present a 10-15 slide PowerPoint presentation (group component = 10%) and write up a 2-3 page individual reflection (plus references) focusing on 1) your contribution to the group project; 2) what you learned from the course that you plan to apply in your profession (individual component = 5%). Your individual component should include a title page, be double-spaced, 12 point size throughout the paper, include references to resources that you built on in this course. Try to follow the APA style for consistency and academic integrity.

Once you’re set up with a group and topic, plan to meet with your group to work on the project, and reach out to your TA for appointment if you have any questions.

Course Policies and Submission of Assignments

Assignments: Assignments should be submitted by the due date electronically via Quercus. Late assignments will be subject to a late penalty of 5% per day (including weekends) of the total marks for the assignment. Assignments submitted five calendar days after the due date will be assigned a grade of zero. Please do not put your assignments in my mail box at Sydney Smith Hall.

Missed assignments and mid-term test: One re-write for midterm exam will be arranged by the department for eligible students.

Informing Your Instructor and Submitting Appropriate Documentation: Students must submit an original University-accepted documentation (e.g., signed U of T medical certificate) within one week of a missed assignment due date or test date. Failure to submit appropriate documentation will result in a grade of zero.
Academic integrity

It is your responsibility as a student at the University of Toronto to familiarize yourself with, and adhere to, both the Code of Student Conduct and the Code of Behaviour on Academic Matters. This means, first and foremost, that you should read them carefully.

**The Code of Student Conduct is available from the U of T website:**
http://www.governingcouncil.utoronto.ca/policies/studentc.htm

**The Code of Behaviour on Academic Matters is available from the U of T website:**
http://www.governingcouncil.utoronto.ca/policies/behaveac.htm

**The University’s website on Academic integrity:** www.utoronto.ca/academicintegrity.

**Statement on TurnItIn:** please make sure your assignments are submitted online via the TurnItIn link

“Normally, students will be required to submit their course essays to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University’s use of the Turnitin.com service are described on the Turnitin.com web site”.

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http://www.studentlife.utoronto.ca/as as soon as possible.

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(The main entrance to the building is on Spadina Avenue, just north of the intersection of College Street & Spadina Avenue.)

Toronto, Ontario, M5S 2G8

Phone: 416-978-8060

Email: accessibility.services@utoronto.ca

Fax: 416-978-5729

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http://www.studentlife.utoronto.ca/as/contact-us