

GGR1911 Remote Sensing

University of Toronto, Fall 2020

Lecture: Monday, 10-12 am, every week, online

Lab: Tuesday, 1-3 pm, selected week, online

Instructor

Prof. Jane Liu

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Office hours:

Monday, 1-2 pm, Thursday, 1-2 pm,

Teaching Assistants

Mr. Yihong Liu

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Office hours: TBA

Course Description

This graduate course is offered to graduate students of diverse backgrounds, and therefore it does not require prior training in remote sensing. Similar to GGR 337, the emphasis of this course is on the basic concepts and skills in using remote sensing data. However, graduate students are expected to learn additional skills in using remote sensing imagery for environmental research, as a way to encourage you to use remote sensing techniques for your graduate research.

Learning Outcomes

After successfully completing GGR337H, students will be able to:

- Understand fundamental principles of electromagnetic radiation as applied to remote sensing;
- Appropriately use basic concepts related to remote sensing observations;
- Acquire the basic knowledge on the characteristics of the main existing spaceborne and airborne remote sensing systems;
- Have the ability to conduct applications of remote sensing techniques to real-world environmental issues;

- Use an image processing tool to implement basic operations with remote sensing images and conduct quantitative analysis.

Evaluation

	<u>Weight</u>	<u>Due Date</u>
Assignment 1	5%	Oct. 5, 2020
Assignment 2	10%	Oct. 19, 2020
Midterm	15%	Oct. 26, 2020
Assignment 3	10%	Nov. 2, 2020
Assignment 4	10%	Nov. 23, 2020
Term paper	25%	Dec. 7, 2020
Final exam	25%	Examination period

This course is cross-listed with a undergraduate course, GGR337. All graduate students should finish the first four laboratory assignments in the same way as undergraduate students. Graduate students will also write the same mid-term and final exams. A term paper (less than 10 double-spaced pages, excluding figures and tables) on a chosen remote sensing topic will be required as a replacement for Lab. 5 in the undergraduate course. A list of topics for the term papers will be given before the reading week. The topic can also be self-chosen, and those related to your graduate research are encouraged. In the final exam, graduate students will be asked to answer one additional question worth about 5% of the exam.

Tutorials/Practicals

	<u>Date (Tuesday)</u>	<u>Topic</u>
Lab 1	Sep. 22, 2020	Radiation
Lab 2	Oct. 6, 2020	Introduction to Image processing
Lab 3	Oct. 20, 2020	Registration of images
Lab 4	Nov. 3, 2020	Image enhancement and modeling

Submissions

All assignments should be submitted electronically on Quercus by 8 pm on the due days.

Delivery method

All lectures and labs will be offered online. Lectures will be offered every Monday, 10-12 at noon. Labs will be offered on selected Tuesday, 1-3 pm (see Course Schedule). Pre-recorded lectures and lab demonstrations will be posted on Quercus before the scheduled time. Students can watch these recordings at the scheduled or a later time.

Access to Course Materials & Readings

Course materials and readings will be posted on Quercus, accessible to students.

Access to Computer Software ArcGIS

The lab sessions of this course require usage of ArcGIS. If students are able to install ArcGIS on their own computers, that would be the best option. Otherwise, they will be able to remotely access to IIT computers via Remote Desktop at the Geography Department Lab at St. George campus. A detailed guide will be provided in Quercus.

Recording/electronics usage

Students can access the course materials in Quercus from a electronic device, e.g., a computer.

Communication

The instructor and teaching assistants are available in online lectures, labs, office hours. Students are encouraged to ask questions during these times, also through emails (see Instructor and Teaching Assistants). Extra office hours can be arranged. One to one appointment can also be arranged. If you feel that you are having difficulty keeping up with assignments or understanding the material we are covering, please contact the instructor as soon as possible.

Course Policies

Assignments: Late assignments will be subject to a late penalty of 10% per day (including weekends) of the total marks for the assignment. Assignments submitted five calendar days beyond the due date will be assigned a grade of zero.

Missed Quiz/Test: There will be no re-writes or make-ups for term tests/quizzes missed for University-accepted, verifiable reasons. Instead the final exam will be re-weighted by the value of the missed term test/quiz.

Informing Your Instructor and Submitting Appropriate Documentation: Students must submit a 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. Please submit original documentation.

Required Text

Campbell, J. B., 2011, *Introduction to Remote Sensing*, Fifth edition, Guilford Press.
ISBN: 978-1-59385-319-8.

Reference Books

Verbyla, D. L., 1995, *Satellite Remote Sensing of Natural Resources*, Lewis

Publishers, New York. ISBN:1-56670-107-4.

Lillesand, T. M., R. W. Kiefer, and J. W. Chipman, 2015, *Remote Sensing and Image Interpretation*, Seventh edition. ISBN: 978-1-118-34328-9.

Additional Readings

To be provided in Quercus.

Course Schedule

Week	Lecture (Monday, 10-12)	Lecture Topic	Lab (Tuesday,1-3)
1	Sep 14	Introduction to remote sensing principles	
2	Sep 21	Electromagnetic radiation and remote sensing terminology	Lab 1, Radiation, 5%. Due: Oct. 5
3	Sep 28	Spectral characteristics of ground targets	
4	Oct 5	Digital data handling and image enhancement	Lab 2, Introduction to image processing, 10%. Due: Oct. 19
5	Oct 12	Thanksgiving holiday, no classes	
6	Oct 19	Geometric corrections	Lab 3: Registration of images, 10%. Due: Nov. 2
7	Oct 26	Midterm, 15%, Color display	
8	Nov 2	Radiometric corrections	Lab 4: Image enhancement and modeling, 10%. Due: Nov. 23

9	Nov 9	Reading week, no classes	
10	Nov 16	Clustering and unsupervised classification	
11	Nov 23	Supervised classification techniques and accuracy	Lab 5: Image classification, 10%. Due: Dec. 7
12	Nov 30	Satellite orbits and sensors	
13	Dec 7	Multispectral transformations of image data and vegetation indices	
14	Dec 10 (Note: Thursday, 10-12)	Applications of remote sensing Review	Make-up for the Thanksgiving.

Readings

1. Lecture notes.
2. Campbell:

	Lecture Topic	Campbell (v5)	Campbell (v4)
1	Introduction to remote sensing principles	1.1-1.2,1.4-1.6	1.1-1.2,1.4-1.6
2	Electromagnetic radiation and remote sensing terminology	2.1-2.7	2.1-2.7
3	Spectral characteristics of ground targets	6.6,9.8-9.9, 17.3,18.6,19.2	6.6,9.8-9.9, 17.3,18.6,19.2
4	Digital data handling,	4.1,4.4-4.5	4.1,4.4-4.5,

	image enhancement		5.15
5	Geometric corrections	11.9	11.5-6
6	Color display	4.7	
7	Radiometric corrections	11.2	11.4
8	Clustering and unsupervised classification	12.3	12.3
9	Supervised classification techniques and accuracy	12.4,14.4,14.5	12.4, 14.4, 14.5
10	Satellite orbits and sensors	6.1-6.3,6.8	6.1-6.3
11	Multispectral transformations of image data and vegetation indices	17.3,17.6,17.7	17.1-17.7, 17.9
12	Application of remote sensing	17.1	

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For more information please contact Accessibility Services at

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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>

See also the University's website on Academic integrity:
www.utoronto.ca/academicintegrity.

Services

Geography Math Help Centre

A resource for this course is the department's Math Help Centre. Geography TAs will be available to help refresh and explain math concepts and techniques that may come up in your Geography courses. This includes working with formulas, graphing data, completing calculations, and so forth. It does not matter how basic your questions are! No appointment is required, just drop by. There will also be table space available in the room, allowing students to get math help as they work through assignments. Details on location and TA times will be posted here:

<http://geography.utoronto.ca/undergraduate/math-help/>