

GEOG*3420 REMOTE SENSING OF THE ENVIRONMENT

*The University of Guelph, Department of Geography, Environment and Geomatics
Winter 2021, 0.5 Credits*

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Office Hours: Wednesdays 2:30-3:30

COURSE DESCRIPTION

This course provides students with the concepts and technical expertise used to analyze satellite imagery in the field of remote sensing. Students will gain hands-on experience processing multispectral, thermal, and radar images and LiDAR 3D point clouds using advanced analytical software to study environmental processes and systems. The integration of remote sensing and Geographical Information Systems (GIS) is stressed.

This course is part of the geomatics sequence of courses offered by the Geography Department. The required prerequisite course (10.00 credits including GEOG*2420) laid the foundations with an introduction to the processes necessary for an understanding of the physical basis for remote sensing (i.e. energy and the atmosphere). The second-year course (GEOG*2420) introduced basic concepts in earth imaging, focusing more on image interpretation, aerial photography, and photogrammetry. This course (GEOG*3420) provides a more detailed overview of remote sensing, focusing on the processing of satellite imagery and their applications. The final course in the sequence in the geomatics sequence of courses is GEOG*4480 Applied Geomatics, which allows students to further refine their geomatics (GIS and remote sensing) skill through a student-led project.

Topics include:

- Energy-Atmosphere-Earth surface interactions
- Examination of Earth-observation systems and platforms
- Characteristics of data from multi-spectral scanners, thermal and radar sensors
- Digital image processing techniques for manipulating and interpreting imagery
- Change detection
- Point-cloud processing

By the end of this course, each student should have gained:

- An understanding of remote sensing fundamental concepts, such as electromagnetic radiation, and systems, including common platforms.
- A working knowledge of remote sensing data and related digital image processing techniques.

- The ability to utilize advanced remote sensing techniques for applications such as land-use change detection.

COURSE SCHEDULE

The course involves lectures and weekly hands-on computer exercises. The practical exercises provide an applied context to demonstrate the theory and concepts developed in lecture.

Course content will be delivered as a mixture of asynchronous and synchronous components. Formally, the lecture component of the course has three scheduled slots times per week, including Monday, Wednesday, and Friday 2:30 – 3:20 PM. However, given that the Winter semester will be taught remotely due to the Covid-19 pandemic lockdown, and due to scheduling issues (GEOG3420 is scheduled for the same timeslot as GEOG4480 due to an administrative oversight), these scheduled times will be largely unused. Instead, **lectures will be pre-recorded and available asynchronously**. Lecture topics will be divided into a number of smaller video recordings, which may vary in number and length each week. Lecture videos will be posted to the CourseLink page either the weekend before or, on occasion, during the week of the topic. **Students are expected to keep up with the video lectures as they are posted; there are marks for participation (see Method of Evaluation below), which come from regularly watching this content each week.**

In addition to lectures, each student **must attend a synchronous two-hour lab**. Lab sessions will be held for each of the four lab assignments, roughly every second week starting in week 2 (see schedule below).

Lab times

Tues 11:30AM - 2:20PM

Mon 2:30PM - 5:20PM

You may not change your lab period without the permission of the instructor.

Week	Date	Topic ¹	Lab Schedule ²
		Block 1: Introduction and Review	
1	Jan 11	- Introduction - Electromagnetic radiation	
2	Jan 18	- Remote sensing systems and platforms - Digital imagery: rasters, multi/hyper spectral data, file formats	Lab 1 assigned
		Block 2: Digital Data for Remote Sensing	

3	Jan 25	- Digital imagery: rasters, multi/hyper spectral data, file formats - Point cloud data: LiDAR data	
Block 3: Digital Image Processing			
4	Feb 1	- Image pre-processing: missing data, geometric corrections, registration, atmospheric corrections	Lab 2 assigned
5	Feb 8	- Enhancement: contrast enhancement, histogram matching	
Feb 15 Winter Break—No class			
6	Feb 22	- Image transforms: algebraic operations, vegetation indices, principal components analysis, Fourier transform, wavelet transform, RGB-IHS, image fusion	Lab 3 assigned
7	March 1	- Image transforms continued - Image filtering techniques	
8	March 8	- Image classification: supervised, unsupervised, segmentation, and AI	
9	March 15	- Image classification: supervised, unsupervised, segmentation and AI	Lab 4 assigned
10	March 22	- Accuracy assessment	
11	March 29	- Change detection	
12	April 5	- LiDAR point cloud analysis - Course wrap-up	
Exam		Online exam, date to be confirmed	

Notes: ¹. The sequence and topics of lectures is subject to change depending on progression.

². All labs are assigned and due on the day of the week during which your regularly scheduled lab occurs.

Lab Topics

Lab 1: The WhiteboxTools library for analysis of remotely sensed data

Lab 2: Image pre-processing and enhancement

Lab 3: Image filtering and transformations

Lab 4: Image classification

Please consult your TA regarding lab due dates and times; however, generally labs are due when a new lab is assigned.

RECOMMENDED TEXT BOOK

Recognizing that the cost of textbooks is a considerable sum for undergraduate students, I plan to supplement lecture materials with a collection of online resources, including the free online text:

Tempfli K, Kerle N, Huurneman GC, and Janssen LLF (2009). Principles of Remote Sensing: An introductory textbook.

A free [PDF of this textbook](#) is available online.

There is also a full-page version (dated 2004, although I don't see any content changes) available from [ResearchGate](#).

Please note that this text is somewhat dated with respect to some of the topics that we will be covering this semester. I am choosing this text because it is freely available to you. I will draw weekly readings from it but for certain topics I may have to supplement the readings with additional resources.

METHOD OF EVALUATION

Laboratory exercises (4 x 9.5%):	38%
Mid-term examination (Wed. Feb 24):	28%
Final examination:	28%
Participation:	6%

The mid-term and final exams will be an online (CourseLink Quiz), open-book exam. The mid-term is 1-hour long and will be available to write during a 12-hour window on Wednesday February 24 and will. The final exam is also a 1-hour quiz but will be available to write during a 3-day window in the final exam period between Monday April 19 to Wednesday April 21st.

The participation marks come from watching the lecture video content that will be posted each week. In my experience with remote offerings, it can be challenging for students to stay motivated to regularly watch the lecture videos throughout the semester. However, there is no better way to prepare for the exams than to keep up with the lecture content, dedicating time to watch the lectures each week. Therefore, this **6% is intended to provide additional motivation and to further reward those students who follow along with posted lecture content and who participate in the course discussion on the CourseLink forums**. CourseLink allows me to track student progress in digesting lecture videos (number of videos watched and whether they were watched in their full length) and this will be the basis of the participation marks. Each of the 12 weeks of the semester will be weighted 0.5% to sum to this 6% participation grade.

LABORATORY EXERCISES

The labs are designed to facilitate the application of digital image processing techniques to practical real-world problems. It would be advisable to use a USB pen drive for additional storage, mobility, and back-up needs. All labs require that students submit their own work, although students are encouraged to work with their colleagues to learn the software. Students must supply their media for file back-up. Labs begin in the second week of the semester. Note: Material from all lab exercises will be covered on the final exam.

OFFICE HOURS

If you are having difficulties with the lab, please contact the course TA. TA office hours are to be scheduled and will be announced upon first meeting. For any other matters, please feel free to visit me during my office hours or e-mail me.

NOTE TAKING

Students are responsible for taking their own notes during lectures. Materials provided on the course blackboard page are incomplete and are not intended to replace student notes. I am not responsible for providing lecture material for missed lectures.

E-MAIL COMMUNICATION

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

WHEN YOU CANNOT MEET A COURSE REQUIREMENT

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration.

DROP DATE

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

COPIES OF OUT-OF-CLASS ASSIGNMENTS

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

ACCESSIBILITY

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence

of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day. More information: www.uoguelph.ca/sas

ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor. The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.