

GEOG*3420 REMOTE SENSING OF THE ENVIRONMENT

The University of Guelph, Department of Geography, Environment and Geomatics
Winter 2024, 0.5 Credits (DRAFT)

Instructor: Dr. John Lindsay
Email: jlindsay@uoguelph.ca
Office: Hutt Rm. 122
Office Hours: Fridays 10:00-11:00

Prerequisite 10.00 credits, including GEOG*2420

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 hand-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 Geomatic, which allows students to further refine their geomatics (GIS and remote sensing) skill through a student-led project.

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.

Textbook

We will use a digital version of:

Mather, PM and Koch, M, 2011. Computer Processing of Remotely-Sensed Images, 4th Ed. Wiley-Blackwell.

A PDF of this version is available through the Guelph library and therefore does not require purchasing.

Method of Evaluation

Laboratory exercises (5 x 8%):	40%
Mid-term examination (Wed. Feb 28):	30%
Final examination:	30%

The mid-term will be held in class (in person) Wednesday March 1 and will be closed book. The final exam is also in-person and scheduled for 4/19/2024 F 8:30 AM - 10:30 AM (Room TBA).

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. This course will be delivered in-person, with face-to-face lectures and in-person examinations. In addition to lectures, each student ***must attend an in-person two-hour lab***, which will also have an option for students who require a remote learning environment due to the pandemic. Lab sessions will be held for each of the five lab assignments, roughly every second week starting in week 2 (see schedule below).

Lecture Times:

Mondays/Wednesdays/Fridays 1:30 PM - 2:20 PM in MCKN 230

Lab Times:

Mondays 02:30PM – 05:20PM

Tuesdays 11:30 AM - 2:20 PM

You may not change your lab period without the permission of the instructor. The following is a preliminary schedule of lectures/labs and is subject to change.

Week	Date	Topic ¹	Lab Schedule ²
		Block 1: Introduction and Review	
1-M	Jan 8	Introduction	
1-W	Jan 10	Electromagnetic radiation	
1-F	Jan 12	Electromagnetic radiation	
2-M	Jan 15	Remote sensing systems and platforms	Lab 1 assigned
2-W	Jan 17	Remote sensing systems and platforms	
2-F	Jan 19	Remote sensing systems and platforms	
		Block 2: Digital Data for Remote Sensing	
3-M	Jan 22	Digital imagery: rasters, multi/hyper spectral data, file formats	
3-W	Jan 24	Digital imagery: rasters, multi/hyper spectral data, file formats	
3-F	Jan 26	Point cloud data: LiDAR data	
		Block 3: Digital Image Processing	

4-M	Jan 29	Image pre-processing: missing data, geometric corrections, registration, atmospheric corrections	Lab 2 assigned
4-W	Jan 31	Image pre-processing: missing data, geometric corrections, registration, atmospheric corrections	
4-F	Feb 2	Image pre-processing: missing data, geometric corrections, registration, atmospheric corrections	
5-M	Feb 5	Enhancement: contrast enhancement, histogram matching	
5-W	Feb 7	Enhancement: contrast enhancement, histogram matching	
5-F	Feb 9	Image transforms: algebraic operations, vegetation indices, principal components analysis, Fourier transform, wavelet transform, RGB-IHS, image fusion	
6-M	Feb 12	Image transforms: vegetation indices, principal components analysis, Fourier transform, wavelet transform, RGB-IHS	Lab 3 assigned
6-W	Feb 14	Image transforms: vegetation indices, principal components analysis, Fourier transform, wavelet transform, RGB-IHS	
6-F	Feb 16	Image transforms: vegetation indices, principal components analysis, Fourier transform, wavelet transform, RGB-IHS	
	Feb 19	Winter Break—No class	
	Feb 21	Winter Break—No class	
	Feb 23	Winter Break—No class	
7-M	Feb 26	Image filtering techniques	
7-W	Feb 28	Mid-term exam	
7-F	Mar 1	Image filtering techniques	
8-M	Mar 4	Image classification: supervised, unsupervised, segmentation, ML	Lab 4 assigned
8-W	Mar 6	Image classification: supervised, unsupervised, segmentation, ML	
8-F	Mar 8	Image classification: supervised, unsupervised, segmentation, ML	
9-M	Mar 11	Image classification: supervised, unsupervised, segmentation, ML	
9-W	Mar 13	Image classification: supervised, unsupervised, segmentation, ML	
9-F	Mar 15	Change detection	
10-M	Mar 18	Change detection	Lab 5 assigned

10-W	Mar 20	Change detection	
10-F	Mar 22	Accuracy assessment	
11-M	Mar 25	Accuracy assessment	
		Block 4: Point Cloud Processing	
11-W	Mar 27	LiDAR point cloud analysis	
11-F	Mar 29	No class (holiday—Easter)	
12-M	Apr 1	LiDAR point cloud analysis	
12-W	Apr 3	Wrap-up	
12-F	Apr 5	Wrap-up	
13-M	April 8	Wrap-up	
Exam	April 19	8:30 AM- 10:30 AM	

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 Whitebox Workflows for Python library

Lab 2: Image pre-processing and enhancement

Lab 3: Image filtering and transformations

Lab 4: Image classification

Lab 5: Change detection

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

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 independent work. 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.

Email 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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

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 outlined 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.

Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via Courselink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment). Students are also responsible for the course content for period of absence due to illness and should be prepared to get notes shared by classmates who were able to attend.

COVID-19 Safety Protocols

For information on current safety protocols, follow these links:

<https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/>

<https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces>

Please note, that these guidelines may be updated as required in response to evolving University, Public Health or government directives.