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Office: Hutt Rm. 346  
Office Hours: TBA

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.

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. This course will be delivered in a hybrid mode, with face-to-face lectures that will also be broadcast via Zoom for synchronous viewing by students who require a remote option. In addition to lectures, each student must attend a synchronous 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 four lab assignments, roughly every second week starting in week 2 (see schedule below).

**Lab times**
Mondays 08:30AM - 10:20AM
Mondays 12:30PM - 02:20PM
You may not change your lab period without the permission of the instructor.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic1</th>
<th>Lab Schedule2</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Block 1: Introduction and Review</strong></td>
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<tr>
<td>1</td>
<td>Jan 11</td>
<td>- Introduction</td>
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<td></td>
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<td>- Electromagnetic radiation</td>
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<td>2</td>
<td>Jan 18</td>
<td>- Remote sensing systems and platforms</td>
<td>Lab 1 assigned</td>
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<td><strong>Block 2: Digital Data for Remote Sensing</strong></td>
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<td>3</td>
<td>Jan 25</td>
<td>- Digital imagery: rasters, multi/hyper spectral data, file formats</td>
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<td>- Point cloud data: LiDAR data</td>
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<td><strong>Block 3: Digital Image Processing</strong></td>
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<td>4</td>
<td>Feb 1</td>
<td>- Image pre-processing: missing data, geometric corrections, registration, atmospheric corrections</td>
<td>Lab 2 assigned</td>
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<td>5</td>
<td>Feb 8</td>
<td>- Enhancement: contrast enhancement, histogram matching</td>
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<td>Feb 15</td>
<td>Winter Break—No class</td>
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<td>6</td>
<td>Feb 22</td>
<td>- Image transforms: algebraic operations, vegetation indices, principal components analysis, Fourier transform, wavelet transform, RGB-IHS, image fusion</td>
<td>Lab 3 assigned</td>
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<td>7</td>
<td>March 1</td>
<td>- Image transforms continued</td>
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<td>- Image filtering techniques</td>
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<td>8</td>
<td>March 8</td>
<td>- Image classification: supervised, unsupervised, segmentation, and AI</td>
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<tr>
<td>9</td>
<td>March 15</td>
<td>- Image classification: supervised, unsupervised, segmentation and AI</td>
<td>Lab 4 assigned</td>
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<td>10</td>
<td>March 22</td>
<td>- Accuracy assessment</td>
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<td>11</td>
<td>March 29</td>
<td>- Change detection</td>
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<td>12</td>
<td>April 5</td>
<td>- LiDAR point cloud analysis</td>
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<td>- Course wrap-up</td>
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<td><strong>Exam</strong></td>
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<td><strong>Online exam, date to be confirmed</strong></td>
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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:


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

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 10%): 40%
- Mid-term examination (Wed. Feb 24): 30%
- Final examination: 30%

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.

**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.

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 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).

For information on current safety protocols, follow these links: Preparing for your safe return and Classroom Spaces.

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

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 make a booking at least 7 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 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.