University of Maine, School of Forest Resources (SFR)

SFR 406 | Remote Sensing of the Forest Environment

Fall Term, 2022

Overview: In this course, students will learn the key concepts and rationale underlying the acquisition, interpretation, processing and presentation of remote sensing imagery for forestry and natural resources applications. Students are introduced to a wide array of remote sensing technology, methods and applications, including: airphoto interpretation; digital photogrammetry; satellite image analysis; and LiDAR forest inventory. With an emphasis on hands-on demonstrations and laboratory exercises, students will gain proficiency in working with digital imagery and other geospatial data using GIS and image processing software, including developing and analyzing vegetation indices, land cover classifications, forest change maps and three-dimensional point clouds. **Prerequisites:** MAT 122 or SFR 208; SFR 400 or GIS equivalent. **Course Offered:** Annually, Fall Term.

Instructors: Tony Guay (anthony.p.guay@maine.edu) and Dave Sandilands (david.sandilands@maine.edu), Nutting Room 260 (office hours open door or by appointment)

Course Format: This course has been developed with a "flipped classroom" design where students study concepts and other topical content outside of the classroom, and then apply those concepts to real-world tasks and problem-solving during class time. There is little to no class time devoted to traditional lecturing by the instructor or passive consumption of the content by students. Instead, lectures on each topic are available as pre-recorded videos that students watch and learn from before coming to class. Without in-class lectures, class time is instead used for active learning where the instructor and students work together on hands-on exercises in the field and on the computer. There is no textbook assigned for this course, but an abundance of highly useful on-line resources such as the Remote Sensing Tutorial (Natural Resources Canada) are available for aiding in understanding concepts and developing the key practical skills. SFR's Wheatland Geospatial Lab (WGL) website wheatlandlab.org provides information about our remote sensing and geospatial program, projects, and personnel, and you can check us out on Twitter @WheatlandLab.

Course Organization: Course announcements, content, data sets, assignments, and assessments will be managed through *Brightspace*, the learning management system used by UMaine. Students will find pre-class content on this semester's SFR 406 course page, including the pre-recorded lecture videos to be watched before the first class time of each week. Except for outside activities and where otherwise noted, class will meet in the GIS computer classroom: the **Barbara Wheatland Geospatial Analysis Laboratory**, Rooms 235/245 Nutting Hall.

- **Topic discussions & Hands-on Demonstrations:** Wednesdays, 9:00 AM – 10:50 AM
- **Lab Sections:** Thursdays, 12:00 PM – 2:50 PM

Course Goals & Objectives: The primary goal is to provide students with working knowledge of how to acquire, handle, interpret, and derive measurements and forest type and change information from aerial photos and create derived map products through the processing of digital images. A major objective is to present practical information about aerial and satellite remote sensing systems, techniques and applications in mapping and monitoring of forests and their social-environmental context.

- **Learning Outcome (3):** Interpret and explain the components, patterns, and processes of biological and ecological systems across spatial and temporal scales.

- **Learning Outcome (21):** Use computers and other technologies for communication, measurement, analysis, and problem solving.

Learning Objectives. Progressing toward the completion of the course, students will be expected to:

1. Understand the theory and methods of photographic and non-photographic remote sensing, particularly as applied to tree, stand and forest landscape measurement, mapping, and monitoring.
2. Understand the concepts behind the interaction of electromagnetic energy with the atmosphere and surface features of the Earth, how that determines the spectral reflectance properties of different forest and land cover types, and how remote sensing exploits them for vegetation analysis.
3. Understand the tradeoffs of different types of remote sensing systems, their resolution, availability, and suitability for various levels of forest and landscape mapping, monitoring, and management applications.
4. Understand the advantages and limitations of remote sensing based analysis approaches, along with the ground-based data necessary to train and test them.
5. Understand basic characteristics of digital image data and processing, and how the data are interpreted and integrated for spatial analysis of forest landscapes.
6. Become proficient in making 2-D and 3-D measurements on aerial imagery, point clouds, and raster maps using scale relationships.
7. Become experienced with ArcGIS and other GIS / image processing software for making measurements, developing forest cover maps and assessing their accuracy.
8. Become experienced with ArcGIS and other software for preparing professional quality, scientific data products and presentation materials.
9. Become an effective scientific / professional writer and communicator.

Attendance: All sessions should be attended because information presented will supplement the readings, videos, and other content available outside of class that will be essential for completing the in-class hands-on exercises and assignments. Attendance is **required** for all laboratory exercises. Only students with excused absences will be allowed to make up a lab.

Academic Honesty: Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

Students Accessibility Services: If you have a disability for which you may be requesting an accommodation, please contact Student Accessibility Services, 121 East Annex, 581.2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with one of the instructors privately as soon as possible.

Observance of Religious Holidays/Events: The University of Maine recognizes that when students are observing significant religious holidays, some may be unable to attend classes or labs, study, take tests, or work on other assignments. If they provide adequate notice (at least one week and longer if at all possible), these students are allowed to make up course requirements as long as this effort does not create an unreasonable burden upon the instructor, department or University. At the discretion of the instructor, such coursework could be due before or after the examination or assignment. No adverse or prejudicial effects shall result to a student's grade for the examination, study, or course requirement on the day of religious observance. The student shall not be marked absent from class due to observing a significant religious holiday. In the case of an internship or clinical, students should refer to the applicable policy in place by the employer or site.

Sexual Discrimination Reporting: The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination involving members of the campus, your teacher is required to report this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

For confidential resources on campus: Counseling Center: 207-581-1392 or Cutler Health Center: at 207-581-4000.

For confidential resources off campus: Rape Response Services: 1-800-310-0000 or Partners for Peace: 1-800-863-9909.

Other resources: The resources listed below can offer support but may have to report the incident to others who can help:

For support services on campus: Office of Sexual Assault & Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-

4040 or 911. Or see the OSAVP website for a complete list of services at www.umaine.edu/osavp/

Assessment & Evaluation: This course will include various opportunities to celebrate your new knowledge of remote sensing as you take part in class activities, including attendance and active participation, study guides, lab reports, and a semester mapping project.

Item	Qty.	Pts. / Ea.	Tl. Pts.	Pct.
Attendance & Participation	15	5	75	15%
Study Guides	7	25	175	35%
Lab Reports	4	30	120	24%
Term Project Abstract	1	30	30	6%
Term Project Poster	1	100	100	20%
Total			**500**	**100%**

Letter Grade	From	To
A	93	100
A-	90	93
B+	87	90
B	83	87
B-	80	83
C+	77	80
C	73	77
C-	70	73
D+	67	70
D	63	67
D-	60	63
F	0	60

Course Schedule Disclaimer: In the event of an extended disruption of normal classroom activities (due to COVID-19 or other long-term disruptions), the format for this course may

be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

COURSE SCHEDULE OF TOPICS:

Week	Week of	Demo Exercise	Content Discussion	Lab Exercise	Assessment (due following Thurs.)
1	**Aug. 29**	All About Air Photos	Intro to Remote Sensing	Determine Map & Photo Scale	SG 1: Learn about Map & Photo Scale
2	**Sept. 5**	Image Search & Download	Aerial Imagery Acquisitions	Plan a Flight Acquisition	SG 2: Learn about Imagery
3	**Sept. 12**	Photo Interpretation	Electromagnetic Reflectance	Interpret Stand Types	SG 3: Learn about Color
4	**Sept. 19**	3-D Trees	Photogrammetry	Analyze UAS Canopy Imagery	SG 4: Learn about Drones
5	**Sept. 26**	UAS Image Acquisition	Unoccupied Aerial Systems	Measure UAS Image Point Clouds	SG 5: Learn about Lidar
6	**Oct. 3**	Lidar Point Clouds	Intro to Lidar	Make Individual Tree Measurements from Lidar	SG 6: Learn about Landsat
7	**Oct. 10**	Guest Lect. / Intro to RS Syst.	Remote Sensing Systems	Analyze Multispectral Imagery	Image Analysis Lab 1 Report
8	**Oct. 17**	Image Processing Workflow	Digital Image Processing	Map Your Study Area	Project Abstract (draft)
9	**Oct. 24**	Create Training Data	Land Cover / Land Use Classification	Digitally Classify Forest Land Cover	Project Abstract
10	**Oct. 31**	Create Reference Data	Accuracy Assessment	Create & Analyze the Error Matrix	Classification & Accuracy Lab 2 Report
11	**Nov. 7**	Spectral Vegetation Indices	Vegetation Analysis	Guest Lect.	SG 7: Learn about Earth Observation
12	**Nov. 14**	Change Detection Methods	Forest Disturbance Processes	Map & Analyze Change	Vegetation Analysis & Change Lab 3 Report
13	**Nov. 21**	NO CLASS/ LAB (Thanksgiving Break)			
14	**Nov. 28**	Lidar: Area-based Models	Enhanced Forest Inventory	Map & Analyze EFI Variables	Lidar EFI Lab 4 Report

15	**Dec. 5**	Work on your project	Work on your project	Work on your project or poster presentations	Final Poster
16	**Dec. 12**	(FINALS)		Poster Presentations (Wed. 12/14 | 2:45 - 4:45pm)	