

INTRODUCTION TO REMOTE SENSING

(GIS4035|5034 || Fall 2021)

Instructor:

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Lecture Hours:

Monday: 2:20 – 4:50 p.m., Bellamy 208

Lab Session:

Monday: 5:00 - 6:30 p.m., Bellamy 035

(You must register the one-hour remote sensing lab session: GIS4035L for GIS4035 students or GIS5034L for GIS5034 students)

Office Hours:

Fridays: 12:00 – 2:00 p.m.; largely through Zoom but in person meetings possible upon request

Lab Instructor/Teaching Assistant:

Yuemeng Gao (yg21g@my.fsu.edu)

Computing Lab Manager (any problem related to the computing system):

Shawn Lewers (slewers@fsu.edu)

Course Description and Objectives

This course emphasizes the understanding of the aerospace remote sensing foundations and the use of remote sensor data and image interpretation and processing techniques for environmental and urban applications. Specifically, the course will cover concepts and foundations of remote sensing, aerial photography and photogrammetry, visual image interpretation, characteristics of various sensing systems (*i.e.*, multispectral, thermal, hyperspectral, microwave and LIDAR), and an introduction to digital image processing techniques. The primary objective of this course is to provide students with the conceptual foundations and the technical skills to apply remote sensing for problem solving in environmental and cultural domains. Through laboratory work, students will have opportunities to practice the concepts and techniques learnt in the lectures. A weekly discussion of recent peer-reviewed journal articles is required for each graduate participant.

Laboratories

Attendance for the one-hour lab session is required. The labs are integral part of the course and attendance is absolutely needed. Lab assignments are to be completed and handed in to the lab instructor before a due day that can be found from your assignment sheet. Some lab assignments may require you to spend your own time to complete, and you should contact your lab instructor/teaching assistant or myself for any questions.

Prerequisites

Currently, this course has no specific prerequisites. However, a range of background knowledge and skills being related especially to physics is expected and even productive. In fact, remote sensing has a strong

connection with physics. If you do not feel comfortable with any basic concepts in physics, you should try to read a textbook on physics.

Note that this course requires a great deal of patience and a substantial time commitment. If you have any question about this, please contact the instructor.

Computing Environment, Software and GIS Lab Policies

The windows-based ERDAS Imagine software package will be used for some lab assignments. However, you must be aware that this is **NOT** a software training course. *If you are looking for such a course (learning a specific software package), you should visit the homepages for specific software packages. These vendors may provide short training courses or software-specific training materials.*

You are expected to observe the related policies when using the lab facilities.

You will be given a temporary account to log on a computer in COSS GIS Lab. This account may expire by the end of the semester. When you are at the computer lab, you must observe the COSS GIS lab and FSU's related policies. The GIS lab rules include (on the following page):

- *No food or drink in the lab.*
- *Lab computers are for GIS work only. Your other class work is to be done in other labs.*
- *Lab printers (if any) are for GIS work only.*
- *DO NOT install software without permission from your instructor or the lab manager. If you need software, ask!*
- *DO NOT save your work on the local machines. Use your Z:\ drive. If you use the local machine or temp directory, others will be able to see your work and it may not be there later.*
- *DO NOT waste color prints (if any), as they are expensive. Use the black and white printer whenever possible.*
- *Be courteous of others in the lab and stay quiet.*
- *Clean up after yourself. Lab attendants will throw out things that are left behind.*
- *DO NOT remove equipment that belongs in the lab from the lab. You will be criminally prosecuted if you are caught.*
- *DO NOT download MP3 or movie files. Most of these websites are compromised by viruses.*
- *Always log-off the computers when you are done, but DO Not shut them down.*
- *No instant messaging is allowed.*
- *Follow the FSU Honor Code and Code of Conduct rules and behave in an adult-like manner.*

It is your responsibility to check and observe these rules. Any violation of these rules can result in the loss of privileges to use this facility. If that happens, it is your responsibility to find an alternative so that you could work on your lab assignments. If you are unsure about a rule or rules, ask a lab employee or Shawn Lewers (slewers@fsu.edu).

Course CANVAS Site

CANVAS will be used to host the course lecture and lab materials. You may find my lecture slides there, but there is no guarantee that these lecture materials will be available on time. You will still need to take notes during a lecture session. You are expected to check that site from time to time because some important announcements may be posted there. The CANVAS address is: <https://canvas.fsu.edu>. You will need to use your FSU account username and password to access this site.

I plan to post the information concerning the Zoom meetings for my office hours on the CANVAS site. Please do not share the Zoom meeting information with a third person.

For copyright reason please do not distribute anything posted on the CANVAS site to a third person.

Grading Policies

Grading System

A	93-100	B-	80-82	D+	67-69
A-	90-92	C+	77-79	D	63-66
B+	87-89	C	73-76	D-	60-62
B	83-86	C-	70-72	F	59-0

In qualitative terms, the grade standards are **A**: Outstanding, few errors or omissions (if any); **B**: Good, only minor errors/omissions; **C**: Satisfactory, at least one major error/omission; **D**: Poor, several major errors/omissions; and **F**: Fail: many major errors/omissions.

Grading Components (the lab grade is combined with the lecture grade to form a combined grade)

Components	Description	GIS4035	GIS5034
Two exams	Open book; non-cumulative	60%	
Lab assignments	There are nine lab assignments to complete within a fixed time frame	30%	
Literature review (GIS5034 only)	Review one peer-reviewed journal article (a review presentation, discussion, and report)		10%
Remote sensing story (GIS4035 only)	Share an interesting story relating to remote sensing theories or applications to the entire class	10%	

Course Attendance

Students are required to attend all classes and be punctual. Missing even one lecture can affect your grade substantially. Announcements regarding the course structure and the change of schedule for lectures, labs, and exams may be made in class. All organizational/administrative announcements made during the class period are assumed to be known by all students.

Attendance will be regularly checked. If you are not able to attend a class meeting, you will need to contact the instructor with an excuse provided. Usually, a substantial excuse should be provided for the second time when you miss a class meeting. A 10% of the total grade reduction will be applied for each unexcused absence. Being late or leaving earlier twice will be counted as ONE unexcused absence.

If you have to miss the class meeting during an exam day or during the date you are scheduled to review your article or present your remote sensing story, you will have to provide an acceptable excuse (before I can reschedule a date for you to take the exam or review the article/story).

The list of acceptable excuses includes documented illness, deaths in the immediate family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. Consideration will also be given to students whose dependent children experience serious illness. Most other excuses for missing an exam may not be acceptable.

Cell phones, pagers, alarms, laptops, calculators, and other electronic devices must always be turned off in class.

Course Exams

An exam can involve any material covered in lectures, reading or discussion assignments, and labs. There is no provision for extra credit work. *A make-up exam could be arranged only when one presents an acceptable excuse (see the list above) that must be verified by the Academic Dean's Office. The request to take a make-up exam must be submitted no later than the actual exam date.* This policy will be strictly enforced.

Lab Grading Policies

The lab grade will be combined with other components (i.e., exams and article review) to form a single grade for the entire class. Grades of your lab exercises are based on the quality of your answers. Any answer should be concise and be well organized. The grade for each lab assignment is reported as *points_scored/total_points_of_exercise*. For example, if an assignment is worth 20 points and your answers score 16 points then you should see 16/20 on your marked assignment.

Each assignment will have a due day clearly written on the first page of your lab assignment. The due time is 11:59 p.m. on the due day. Any assignment that is turned in after the due day is considered late, which will receive penalty strictly.

The penalty for a late assignment is based on the number of days late (including weekends). If an assignment is late less than 24 hours, it is considered 1 day late. If an assignment is late less than 48 hours but more than 24 hours, it is considered 2 days late, and so on. Late assignments are penalized 20% per day. Here is the formula for calculating the points of a late assignment:

$$\text{Points}_{\text{get}} = \text{Points}_{\text{scored}} - 0.20 * \text{Num}_{\text{days}_{\text{late}}} * \text{Total}_{\text{points}}$$

The minimum value of $\text{Points}_{\text{get}}$ is 0. Assignments handed in after I have returned the graded assignment to class (usually one week after the due date) will receive no points. Again, you must provide acceptable excuse (see the exam section) in order to receive more time for you to complete lab exercises without penalty applied. You should discuss with your lab instructor about your situation no later than the due day. This policy will be strictly applied.

Note that every person must hand in his or her own lab assignments. Working together is permitted and encouraged. BUT each person will be graded separately, must answer "creative response" questions independently, and must create his or her OWN maps (if any). Turning in identical or substantially similar assignments will result in a significant grade reduction.

Literature Review and Discussion

Each graduate participant (GIS5034) is required to review one journal article chosen by himself/herself. The article must be chosen from a peer-reviewed journal (check Section Course Materials for details). **NO** web materials can be used to replace a peer-reviewed journal article. Each graduate participant needs to do a short presentation and lead the article discussion. The leader is expected to prepare 3-5 questions relevant to the article in one week before the actual discussion. These questions should be posted on the CANVAS site momentarily with the help of the course instructor, and each student will need to address these questions when reading through that article. The leader should prepare several slides to initiate the discussion and summarize the major findings resulting from the classroom discussion. The summary report is due one week after the discussion. Each discussion session could run up to 20 minutes depending upon the topic. All students are expected to actively participate in the discussion.

The instruction for the remote sensing story component will be discussed in the class.

Course Materials

Suggested Supplies: You may need a pencil, an eraser, a magnifying glass, and a calculator for some of your lab assignments.

Required Textbook: Lillesand, T.M., Kiefer, R. W. and Chipman, J.W. 2015. *Remote Sensing and Image Interpretation* (7th). New York: Wiley. 768p (This book is required and can be acquired from the campus bookstore or through Amazon or some other online sites. Either a digital version or a hardcopy should be good).

Other Textbooks:

- Aronoff, S. 2005. *Remote Sensing for GIS Managers*. Redlands. California: ESRI Press. 487p.
- Berlin, G. L.L. and Avery, T.E. 2003. *Fundamentals of Remote Sensing and Airphoto Interpretation* (6th). Upper Saddle River, N.J.: Prentice Hall. 540p.
- Campbell, J.B. and Wynne, R. H. 2011. *Introduction to Remote Sensing* (5th). New York: Guilford Publications. 667p.
- Chuvieco, E. 2020. *Fundamentals of Satellite Remote Sensing: An Environmental Approach* (3rd). CRC Press. 432p.
- Curran, P.J. 1985. *Principles of Remote Sensing*. London: Longman. 282 p.
- Donnay, J. P., Barnsley, M. J., and Longley, P.A. 2001. *Remote Sensing and Urban Analysis*. London: Taylor & Francis. 268p.
- Drury, S. A. 2004. *Image Interpretation in Geology*. Routledge. 304p.
- Gibson, P. and Power, C. 2000. *Introductory Remote Sensing: Digital Image Processing & Applications*. Routledge Chapman & Hall. 288 p.
- Green, K., Congalton, R. G., and Tukman, M. 2017. *Imagery and GIS: Best Practices for Extracting Information from Imagery*. ESRI Press. 419 p.
- Hopkins, M. 2018. *Introduction to Remote Sensing*. Syrawood Publishing House. 231p.
- Jensen, J. 2005. *Introductory Digital Image Processing: A Remote Sensing Perspective* (3rd). Upper Saddle River, N.J.: Prentice Hall. 526 p.
- Jensen, J. 2007. *Remote Sensing of the Environment: An Earth Resource Perspective* (2nd). Upper Saddle River, N.J.: Prentice Hall.
- Landgrebe, D. A. 2003. *Signal Theory Methods in Multispectral Remote Sensing*. New Jersey: Wiley-Interscience. 508p.
- Liang, S. 2004. *Quantitative Remote Sensing of Land Surfaces*. New Jersey: Wiley-Interscience. 534p.
- Lo, C. P. 1986. *Applied Remote Sensing*. New York: Longman. 393 p.
- Lunetta, R.S. and Elvidge, C.D. (eds.) 1998. *Remote Sensing Change Detection: Environmental Monitoring Methods and Applications*. Chelsea, Michigan: Ann Arbor Press. 318 p.
- Mather, P.M. and Koch, M. 2004. *Computer Processing of Remotely-Sensed Images* (4th). Chichester: Wiley. 460p.
- Paine, D. P. and Kiser, J.D. 2012. *Aerial Photography and Image Interpretation* (3rd). New Jersey: Wiley. 648p.
- Rees, W.G. 2013. *Physical Principles of Remote Sensing* (3rd). Cambridge University Press. 460 p.
- Richards, J.A. and Jia, X. 2012. *Remote Sensing Digital Image Analysis* (5th). Berlin: Springer. 512 p.
- Sabins, F.F. and Ellis, J. M. 2020. *Remote Sensing: Principles, Interpretation, and Applications* (4th). Waveland Pr. Inc. 524p.
- Schowengerdt, R. A. 2006. *Remote Sensing: Models and Methods for Image Processing* (3rd). London: Academic Press. 560p.
- Vincent, R. K. 1997. *Fundamentals of Geological and Environmental Remote Sensing*. Upper Saddle River, N.J.: Prentice Hall. 370p.
- Weng, Q. 2012. *An Introduction to Contemporary Remote Sensing*. McGraw-Hill Professional. 320 p.

- Woodhouse, I. H. 2006. *Introduction to Microwave Remote Sensing*. Boca Raton, Florida: CRC Press, 370p.
- Yang, X. (ed) 2009. *Remote Sensing and Geospatial Technologies for Coastal Ecosystem Assessment and Management*. Berlin: Springer, 561p.
- Yang, X. (ed). 2011. *Urban Remote Sensing: Monitoring, Synthesis and Modeling in the Urban Environment*. New York: John Wiley. 408p.
- Yang, X. (ed). 2021. *Urban Remote Sensing: Monitoring, Synthesis and Modeling in the Urban Environment (2nd)*. John Wiley. 576p.

Remote Sensing Journals

- Photogrammetric Engineering and Remote Sensing (ASPRS)
- International Journal of Remote Sensing (Taylor & Francis)
- Remote Sensing of Environment (Elsevier)
- GIScience and Remote Sensing
- ISPRS Journal of Photogrammetry and Remote Sensing
- IEEE Transactions of Geosciences and Remote Sensing
- IEEE Geoscience and Remote Sensing Letters
- Remote Sensing Letters (Taylor & Francis)
- International Journal of Applied Earth Observation and Geoinformation (Elsevier)
- Canadian Journal of Remote Sensing (CRSS)
- GeoCarto International
- International Journal of Digital Earth
- Remote Sensing (An open access journal)

Academic Honor Policy

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to ". . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at <http://fda.fsu.edu/academic-resources/academic-integrity-and-grievances/academic-honor-policy>)

PLAGIARISM: All submitted assignments must be your own original, independent work. All sources must be properly cited (especially in the graduate student paper). Ask the instructor if you are unsure what to do. Plagiarism will result in significant grade reduction.

Academic Success

Your academic success is a top priority for Florida State University. University resources to help you succeed include tutoring centers, computer labs, counseling and health services, and services for designated groups, such as veterans and students with disabilities. The following information is not exhaustive, so please check with your advisor or the Dean of Students office to learn more.

Americans With Disabilities Act

Florida State University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive, and welcoming. FSU is committed to providing reasonable accommodations for all persons with disabilities in a manner that is consistent with academic standards of the course while empowering the student to meet integral requirements of the course.

To receive academic accommodations, a student: (1) must register with and provide documentation to the Office of Accessibility Services (OAS); (2) must provide a letter from OAS to the instructor indicating the need for accommodation and what type; and (3) should communicate with the instructor, as needed, to discuss recommended accommodations. A request for a meeting may be initiated by the student or the instructor. This should be done during the first week of class.

Please note that instructors are not allowed to provide classroom accommodations to a student until appropriate verification from the Office of Accessibility Services has been provided.

This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact the

Office of Accessibility Services
874 Traditions Way
108 Student Services Building
Florida State University
Tallahassee, FL 32306-4167
850- 644-9566 (voice)
850-644-8504 (TDD)
oas@fsu.edu
<https://dsst.fsu.edu/oas>

Confidential campus resources

Various centers and programs are available to assist students with navigating stressors that might impact academic success. These include the following:

Victim Advocate Program
University Center A, Rm. 4100
(850) 644-7161
Available 24/7/365
Office Hours: M-F 8-5
<https://dsst.fsu.edu/vap>

Counseling and Psychological
Services
Askew Student Life Center, 2nd
floor
942 Learning Way
(850) 644-8255
<https://counseling.fsu.edu/>

University Health Services
Health and Wellness Center
(850) 644-6230
<https://uhs.fsu.edu/>

Free Tutoring from FSU

On-campus tutoring and writing assistance is available for many courses at Florida State University. For more information, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of on-campus tutoring options - see <http://ace.fsu.edu/tutoring> or contact tutor@fsu.edu. High-quality

tutoring is available by appointment and on a walk-in basis. These services are offered by tutors trained to encourage the highest level of individual academic success while upholding personal academic integrity.

Syllabus Change Policy

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice. The instructor reserves the right to change the content of the syllabus or course material during the course of the semester. Any changes will be posted in the announcement section on Canvas or be notified through emails. Students should check announcements and your FSU email account timely.

Statement on Public Health Protocols (Approved by FSU Faculty Senate in Fall 2021)

In our classroom, I will expect everyone to wear a proper, well-fitting mask. As our President has informed the university community, FSU expects everyone on campus to use face-coverings. In regions where virus rates are high, the CDC recommends that even vaccinated individuals wear masks in public indoor spaces, like classrooms, especially where social distancing is not possible. Florida infection and hospitalization rates are greater now than they were at the height of the 2020 surge due to the Delta variant, a more infectious and easily transmissible version of the COVID-19 virus. The best way to protect against serious illness is to be fully vaccinated, but not everyone among us can be. Because the Delta variant can infect even vaccinated individuals and can be spread by them to others, it poses a special threat to members of the community with underlying health conditions and children at home who are too young for vaccination.

For these reasons, FSU expects each member of the community to comply with the public health protocols our President set forth on August 9, 2020, including *(1) wearing masks in public indoor spaces, (2) getting fully vaccinated, (3) being tested for the virus if you have symptoms, and (4) staying home and away from others if you are sick.* Please remember that you should NOT attend class in person if you have tested positive for COVID-19 or are quarantining after exposure. Finally, please bear in mind that the COVID-19 situation is fast moving and that university guidance on the issue may change at any time.

Statement for Classes Subject to HB233 Recording (Approved by FSU Faculty Senate in Fall 2021)

In this class, consistent with state law and university policy, students are permitted to make recordings of class lectures for personal use only. As noted, sharing, posting, or publishing classroom recordings may subject you to honor code violations and legal penalties associated with theft of intellectual property and violations of other state law. Moreover, students and educators have expressed concern that recording classroom activities may negatively impact the learning experience for others, especially in classes that involve questions, discussion, or participation. *To protect a learning environment in which everyone feels free to experiment with ideas, we ask you refrain from recording in ways that could make others feel reluctant to ask questions, explore new ideas, or otherwise participate in class.* Students must monitor their recording so that they do not include participation by other students without permission. Students with disabilities will continue to have appropriate accommodations for recordings as established by the Office of Accessibility Services.

Tentative Schedule*

(Fall 2021)

Week	Date	Lecture Topics	Lab Assignments	Reading	Comments
1	8/23	Introducing the course	NA	N/A	A brief meeting
2	8/30	Introducing the course/RS foundation	Internet resources for remote sensing learning	Ch. 1&2	Article review assignment
3	9/06	Labor Day (no class)			
4	9/13	RS foundations (cont.)	Electromagnetic radiation principles	Ch. 2&3	Article title/pdf version
5	9/20	Aerial photography	Viewing digital imagery and understanding digital numbers	Ch.3	Questions from the first two reviewers
6	9/27	Photogrammetry	Basic computations in photogrammetry	Ch. 3	Discussion I
7	10/04				Discussion II
8	10/11	Introducing visual image interpretation	Visual image interpretation	Ch. 8	Discussion III
9	10/18	Lecture and Reading Exam One (covering Weeks 1-8)			<i>Midterm feedbacks (online)</i>
10	10/25	Thermal remote sensing	Thermal infrared image interpretation	Ch. 4	Discussion IV
11	11/01	Earth resources satellites operating in the optical spectrum	Interpretation of multispectral images	Ch. 5	Discussion V
12	11/08				<i>Undergraduate session</i>
13	11/15	Microwave remote sensing	Interpretation of radar images	Ch. 6	Discussion VI/VII
14	11/22				
15	11/29	Introducing digital image processing	Image classification	Ch. 7	<i>Teaching evaluation (online)</i>
16	12/08	Lecture and Reading Exam Two (covering Weeks 10-15)			

* The schedule is subject to change. Please pay attention on my announcements during class meetings or through the CANVAS system.