GEOS/GEOG F422
Geoscience Applications of Remote Sensing

Fall 2021, 3 credits
In person or online synchronous
Lecture: Tue/Thu 09:00-10:00, room: WRRB 004/online
Lab: Tue/Thu 10:00-11:30, room: WRRB 004/online

Instructor: Dr. Simon Zwieback
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Office Hours: TBA, or by appointment

Course Description

Remote sensing and its applications to geologic, environmental and physical sciences. Includes physical principles, digital image processing and hands-on project experience using satellite images for mapping and change detection. Course is not available for audit.

Pre-requisites

PHYS F124X or PHYS F212X, or permission of instructor.

Course Content

The first third of the course provides a general overview of remote sensing, introducing applications of societal relevance, the history of the field, and basic physical principles. We discuss the foundations of image interpretation, focusing on aerial images and multispectral observations (Landsat program). We will analyze these images using remote sensing software packages, drawing on a range of data sources and scientific disciplines.
The second third is centered on a range of imaging modalities, including imaging spectroscopy, light detection and ranging (LiDAR), and microwave systems. The idea is to provide an overview of the measurement principle, common sensors and data

sources, and image processing techniques. Case studies and hands-on labs will showcase real-world applications and convey practical image analysis skills.
In the final third of the course, we will investigate geoscientific applications of remote sensing. We will adopt a domain-science perspective and appraise the contribution of remote sensing to scientific questions relating to geohazards, hydrology, etc. An independent project gives students an opportunity to study an applied problem of their choice.

Student Learning Outcomes

After completing the course, you will be able to

- Quantitatively describe electromagnetic radiation using radiometric concepts and radiation laws
- Contrast spectral signatures and identify the underlying physical phenomena
- Perform and appraise atmospheric corrections of visible and infrared remote sensing observations
- Identify suitable remote sensing techniques, data, and algorithms to answer a given geoscientific question
- Extract information from remote sensing data using state-of-the-art analysis techniques and assess the quality of the results

In contrast to the graduate students, undergraduate students are not expected independently to design remote sensing solutions.

Course Readings/Materials

Textbooks:

- Sabins, F. F. and Ellis, J. M. Remote Sensing Principles, Interpretation, and Applications. Fourth Edition Waveland Press, 2020 (Required)
- Jensen, J. R. Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Edition. 2007. (Recommended)

Additional readings

Additional readings will be posted on blackboard.

Software

All necessary software tools will be available through the computing facilities of the remote sensing computer lab in WRRB 004 or via the university's Virtual Private Network (VPN). Upon request, you will be provided with swipe card access to WRRB 004.

Instructional Methods:

Lecture and lab: The course comprises 2 hours of lecture and 3 hours of lab each week. Distance students will be able to join remotely via Zoom. The lectures will be partly interactive, including group-based image analyses and discussions. Participation in the discussions is required. We will flip the classroom for one week, i.e. the students will be completely in charge of lecture and lab. The labs will focus on remote sensing data processing and analysis using software packages such as ENVI. Lectures and labs will be online synchronous for distance delivery.

Assignments: Students will complete (approximately) bi-weekly homework assignments. The assignments are tightly integrated into the labs.
Term project: The term project addresses an applied problem in remote sensing. The selection of the application is at the student's discretion, upon consultation with the instructor. The project can be conducted individually or in small groups. Each student will present a poster. The students are expected to:

- Provide a compelling rationale for their project and identify a specific objective
- Identify a suitable data set
- Analyze the data set to achieve the objective

Evaluation:

There will be 5 assignments every two to three weeks throughout the semester. Among assignments A1, A3-A5, the one with the lowest score will be dropped. All assignments are closely aligned with the learning outcomes, allowing the student to build a broad skill set in remote sensing data processing, analysis, and interpretation.
There will be a single quiz about the foundations of remote sensing.
Participation credit will be based on the quality and frequency of the student's contribution to group discussions, image interpretation, etc.
Evaluation of the project will be based on the design and clarity of the poster, the question and answer session, and the intrinsic merit of the presented work (e.g., compelling interpretation, critical discussion of limitations).

Course policies

Attendance: All students are expected to attend and participate in all classes and labs. Active participation in class (e.g., group discussions) forms part of the grade. Should reasons emerge that prevent a course participant from attending a lecture or lab, they should consult with the instructor in advance.
Late submission: Unless arrangements are made with the instructor prior to the due date, work that is submitted late will be penalized 10% per day past the deadline.
Independent work: Students are welcome to discuss the assignments with one another. However, the write-up must be individual work. If students decide to conduct a group project, each group member has to design the poster independently (including independent interpretation and discussion) and identify contributions from the other group members.

Grading:

The course grade will be a weighted average of the absolute scores obtained in:

- Assignments: 48%
- Quiz: 12%

- Participation: 15%
- Project: 25%

The final weighted scores (in percent) will be translated to letter grades (with +/-) as follows:

A+ = 97-100% A = 93-96% A– = 90-92%
B+ = 87-89% B = 83-86% B– = 80-82%
C+ = 77-79% C = 73-76% C– = 70-72%
D+ = 67-69% D = 63-66% D– = 60-62%
F = 60% or below

I follow the University of Alaska Fairbanks Incomplete Grade Policy, which states that the letter “I" (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the students control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an ”I" grade.

Tentative course calendar

Week	Topics	Labs	Due
1	Introduction	Remote sensing images	
2	Remote sensing	Image interpretation	
3	Physical principles	Calculations	
4	Photographs	Aerial imagery (A1)	Quiz
5	Multispectral I	Visualizing and understanding images	
6	Multispectral II	Image selection and analysis (A2)	A1
7	Multispectral indices (flipped)	Snow mapping (A3)	
8	Thermal infrared	A2 presentations	Project outline, A2
9	Topographic mapping	Canopy height (A4)	A3
10	Image processing	Classification (A5)	
11	Hyperspectral	Hyperspectral vegetation mapping	A4
12	Microwave	Passive microwave	
13	Applications I		A5
14	Applications II		
15	Thanksgiving		
16	Poster presentation		Poster

Student Protections Statement:

UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: https://catalog.uaf.edu/.

Academic Honesty:

This course will follow and enforce UAF's Center for Student Rights and Responsibilities Academic Misconduct Policy: https://uaf.edu/csrr/student-conduct/academic-misconduct.php
You are responsible for knowing, understanding, and following this policy.

Effective Communication:

Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communications Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English Departments Writing Center (907-474-5314, Gruening 8th floor), and/or CTCs Learning Center (604 Barnette st, 907-455- 2860).

Students with disabilities:

I will work with the Office of Disability Services to provide reasonable accommodation to students with disabilities.

COVID-19 statement:

Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website:
https://sites.google.com/alaska.edu/coronavirus/uaf/uafstudents?authuser=0
Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.